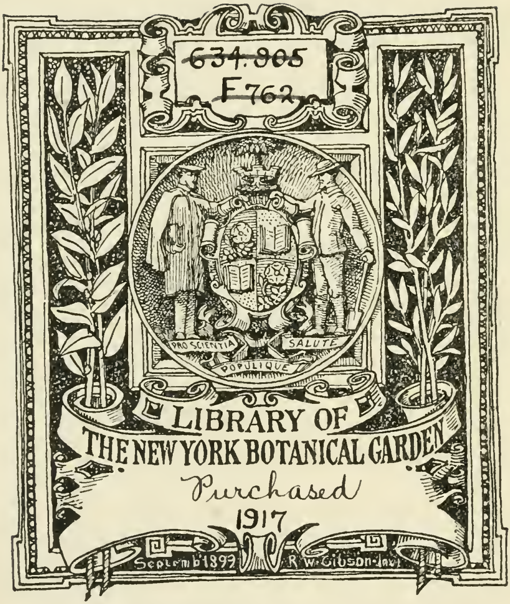

~~634.805~~
~~F 762~~
PRO SCIENTIA
SALUTE
POPULIQUE
LIBRARY OF
THE NEW YORK BOTANICAL GARDEN
Purchased
1917
Septemb 1899
R. W. Gibson Invt

JOURNAL OF FORESTRY

COMBINING FORESTRY QUARTERLY

AND

PROCEEDINGS OF THE

SOCIETY OF AMERICAN FORESTERS

VOLUME XV

SOCIETY OF AMERICAN FORESTERS 1900

With Five Plates, Ten Cuts, Nineteen Diagrams

PUBLISHED BY THE

SOCIETY OF AMERICAN FORESTERS

AT 930 F STREET N. W.

WASHINGTON, D. C.

1917

JOURNAL OF FORESTRY

A professional journal devoted to all branches of forestry

EDITED BY THE EDITORIAL BOARD OF
THE SOCIETY OF AMERICAN FORESTERS

The Journal appears eight times a year—monthly with the exception of June, July, August, and September.

The pages of the Journal are open to members and non-members of the Society.

Manuscripts intended for publication should be sent to Prof. B. E. Fernow, at the University of Toronto, Toronto, Canada, or to any member of the Editorial Board.

Missing numbers will be replaced without charge, provided claim is made within thirty days after date of the following issue.

Subscriptions and other business matters may be addressed to the Journal of Forestry, Atlantic Building, 930 F Street N. W., Washington, D. C.

CONTENTS

INDEX

REVIEWS:

Vol. XV JANUARY, 1917 No. 1

JOURNAL OF FORESTRY

OFFICIAL ORGAN OF THE SOCIETY
OF AMERICAN FORESTERS

PROCEEDINGS AND FORESTRY QUARTERLY COMBINED

THE OBJECTS OF THE JOURNAL ARE:

TO AID IN THE ESTABLISHMENT OF RATIONAL FOREST MANAGEMENT.

TO AFFORD A CHANNEL FOR THE DISCUSSION OF TECHNICAL SUBJECTS OF INTEREST TO PROFESSIONAL FORESTERS OF AMERICA.

TO KEEP THE PROFESSION IN TOUCH WITH THE CURRENT TECHNICAL LITERATURE, AND WITH THE FORESTRY MOVEMENT IN THE UNITED STATES, CANADA, AND OTHER COUNTRIES.

PUBLISHED BY THE
SOCIETY OF AMERICAN FORESTERS
At 930 F STREET N. W.
Washington, D. C.

Single Copies, 50 Cents Annual Subscription, $3.00

Entered as second-class matter at the Post-Office at Washington, D. C., under Act of August 24, 1912

JOURNAL OF FORESTRY

A professional journal devoted to all branches of forestry

EDITED BY THE EDITORIAL BOARD OF
THE SOCIETY OF AMERICAN FORESTERS

The Journal is published 8 times a year, except summer months. Subscription price, $3 a year. Fifty cents for single copies.

The pages of the Journal are open to members and non-members of the Society.

Manuscripts intended for publication should be sent to Prof. B. E. Fernow, at the University of Toronto, Toronto, Canada, or to any member of the Editorial Board.

Subscriptions and other business matters may be addressed to the Journal of Forestry, Atlantic Building, 930 F Street N. W. Washington, D. C.

JOURNAL OF FORESTRY

Vol. XV JANUARY, 1917 No. 1

ANNOUNCEMENT

With this issue the Journal of Forestry takes the place of the Proceedings of the Society of American Foresters and of the Forestry Quarterly. Although the two magazines have been filling a distinct place in the field of professional forestry in North America, one laying particular emphasis on original articles and substantial reviews, the other attempting to cover to a large extent the entire field of forest literature in this country and abroad, the amalgamation of the two into one magazine, it is hoped, will serve the needs of the profession in a more efficient way than did the two parent publications. The new Journal is not an absorption of the Forestry Quarterly by the Proceedings or of the Proceedings by the Forestry Quarterly, but is in the true sense an amalgamation of the best features of the two original publications.

The Journal will be devoted to all branches of forestry and will contain original articles, notes and comments, reviews of books, periodical literature, and news and personal notes. The Journal of Forestry will be published by and for the Society in eight monthly issues, omitting the summer months. It will be the official organ of the Society, and will be distributed to the active members of the Society without charge. Honorary and associate members as well as nonmembers may secure the Journal at the subscription price of $3 per annum and 50 cents for single copies of the current issue.

The Journal will be published under the direction of a Board of Editors appointed by the President of the Society in accordance with the provisions of Section 5, Article V, of the Constitution of the Society. It was understood, however, that as a condition of the transfer of interests in the Forestry Quarterly, Dr. B. E. Fernow shall be appointed by succeeding Presidents as Editor-in-Chief "as long as he is willing to discharge these duties and as long as such action is consistent with the interests of the Society." The Editor of the Proceedings will act, subject also to appointment by succeeding Presidents, as the Managing Editor of the new Journal.

It is expected that the Journal will contain from 800 to 1,200 pages—that is the size of the two parent publications combined—100 to 150 pages for each issue. Since the Journal is to be the organ of the profession, and since the Forestry Quarterly was the first professional organ in the field, the Executive Council thought it advisable to retain the continuity of the professional organ of North America by designating the forthcoming volume of the Journal as Volume XV, the last volume of the Forestry Quarterly being Volume XIV. The new Journal will therefore be a direct continuation of the 14 volumes of the Forestry Quarterly and of the 11 volumes of the Proceedings of the Society of American Foresters. A joint index of the articles published in the 14 volumes of the Forestry Quarterly and in the 11 volumes of the Proceeding is contemplated.

The Editors bespeak an active interest of all readers in making the Journal a worthy organ of the Society and representative of the best thought of the professsion by the contribution of articles, and otherwise. The Editors will welcome any suggestions and criticisms, intended to improve the publication, addressed to any member of the Board.

THE SITUATION[1]

By Professor B. E. Fernow.

It is precisely 30 years—a whole generation—since the speaker took charge of the forestry work of the Federal government, at that titme the only agency of this kind, in a little garret room with two clerks and $10,000 appropriation, and as he was the first professional forester in that position, that date, 1886, may be claimed to be the beginning of at least professional consideration of the forestry problems in the United States.

Looking back over such a period of professional endeavor, the thought naturally suggests itself to review before this Society, the representative of the profession, what has been accomplished in that time in forestry as a policy, a science, and an art.

There are pessimists and optimists in the world, those that see the rosy and those that see the gloomy side of things. Neither the cheerful optimist, although he contributes to the fund of happiness in the world, nor the morose pessimist who chills the enthusiasm of the reformer, advance the world very much by their extravagant praise or criticism. Fifty per cent of either in mixture will make a meliorist, will make us realize what is wrong with the world and suggest the remedy.

It is in the rôle of the meliorist that I propose to deal with my subject.

At the outset we may claim that while in some directions much is still backward, we can be quite proud of what has been accomplished in a comparatively short time. If, for instance, we compare our own efforts with those of the British in India who had a start of 20 years ahead of us, and with those of other Dominions of the British Empire, as Canada, for example, we do not need to feel ashamed of our accomplishment.

The mere statement that appropriations for forestry work have passed beyond the five million dollar mark for the Federal government, to which several million dollars may be added for State government agencies, gives an idea of growth.

There are five directions in which the progress should be traced,

[1]Address of the retiring President before the Society of American Foresters, December 29, 1916.

namely, in the development of forest policies, Federal, State and municipal; in the development of private forestry; in the professional and public educational development; the development in scientific direction, and finally in forestry practice, the actual application of knowledge in the management of forests.

NATIONAL FOREST POLICY

As far as the development of a Federal forest policy is concerned, the outlook at the beginning of the period was almost hopeless: the idea of government ownership, the only possible policy, was repugnant to the general land policy of the United States, which had in view the disposal of public lands to settlers and other private hands.

Nevertheless, the commitment of the Federal government to set aside forest reservations for permanent government ownership was secured within the short space of five years, when in 1891 by a regular *coup d'état* the well-known clause empowering the President to set aside forest reservations was passed as a rider to a bill repealing the timber culture law.

I desire here to place on record, in view of an attempt by a certain ex-Senator to claim the fatherhood of this clause, that according to my very positive recollection the honor of having secured the insertion and passage of this clause into law belongs to the then Secretary of the Interior, John W. Noble, and to him alone, except so far as we had a hand in educating him to the proper attitude.

Within the next three years after the enactment of that clause, some 18 million acres of the public timber domain were withdrawn from the possibility of private entry. Another block of similar size was added in 1897; and these reservations by 1908 had been increased to some 175 million acres. The policy of maintaining National Forests was then finally and definitely established within less than 20 years.

This was not done without considerable opposition, especially on the part of Western Representatives and Senators. Indeed, when in 1897 President Cleveland celebrated Washington's birthday by creating at one stroke some 20 million acres of reserves, it was with great difficulty that the indictment of the President and the abolition of the entire reservation policy was prevented.

Meanwhile, an administration for these forests, especially one based on forestry principles, was more difficult to attain, partly, I take it, because the idea of forest management was novel and professional foresters were not in existence. Ten years of attempts to secure

passage of an administration bill, calling for a complete organization in the Department of the Interior, were without result.

During that period, within three years of the establishment of the first reservation, we succeeded in having this bill passed in both Houses, but by a mishap—the sickness of a child of the Chairman of the Public Lands Committee—it failed to become law.

A first move to at least protect the property more efficiently was made in 1897 under rules and regulations administered by agents of the General Land Office who were in command until 1904. In that year, the management was turned over to the Forest Service in the Department of Agriculture when an administration on professional lines was inaugurated.

Whatever criticisms and fault-finding may be justified as to the detail of organization and administration, we can claim that the tremendous task of placing the Forest Service on an efficient professional basis has been undertaken with a measure of success that more than justifies the pride the profession can feel in it.

When it is considered that the first professional forester graduated from an American forest school in the first year of this century, it is quite remarkable how quickly and how efficiently the change from a superficial political administration to a well-organized professional management was effected. It is a testimony to the efficiency of the Forest Service that it has been able to steer by the cliffs and through the stormy seas, set in commotion by selfish private interests and by false political aims, without losing headway.

Detractors, enemies, objectors had to be appeased and political claptrap to be overcome, while introducing business attitudes and technical management.

In less than 15 years from not only non-existence, but non-comprehension of even the idea of forestry, we may claim the profession, as far as Federal recognition is concerned, has been fully established.

Yet, so fickle and unstable is democratic government, that it is impossible even now to rely upon the permanency of the established policy and service by their momentum alone. Still watchfulness, arguments, and struggle to maintain the policy of National Forests are necessary. Repeated efforts are made by Congressional measures to secure the abandonment of the policy as a whole or in part, or are designed to interfere with a rational administration, and must be met.

During the last winter, for instance, attempts were made in Congress to abolish the Alaska National Forests, and to open to private and

municipal acquisition, under general land-grant laws, parcels of other Forests. Indeeed, it required the veto of the President to prevent such stultifying legislation from being enacted.

In utter contrast with these futile attempts to *weaken* the National Forest policy must be cited the legislation in opposite direction, which has become known as the Weeks law, passed in 1911. This is, indeed, a most remarkable extension of the Federal forest policy, and it is of far-reaching import, not so much for what it has accomplished as for what it implies as regards national policy.

In its provision for cooperation with the individual States in the matter of fire protection it recognizes the mutuality of interest between the nation at large and its single members. In its provision for the purchase of National Forests in the Appalachian and White Mountains, it recognizes the inability of the single States to inaugurate effective forest policies—a matter to which we will presently return.

Such a proposition at the time when we first proposed the reservation of the public timberlands, which were already the nation's property, would surely have led the proposer to a lunatic asylum.

With such a success in reversing old established theories of Federal government and land policy, we may now go still another step and suggest further cooperation with the States in building out State forest policies.

STATE FOREST POLICY

The progress of developing forest policies in the individual States has by no means been so phenomenal.

Although almost all States can be reported as recognizing in some way the need of a forest policy, the practical expression given to this need has been feeble in most States.

The methods of expressing interest have been more or less the same in all States; namely, first, the creation of commissions of inquiry, mostly instituted in the eighties and nineties, and some of them as early as 1867 and 1876 (Wisconsin and Minnesota).

Sooner or later these commissions of inquiry, having made their reports, were followed by more permanent commissions with advisory and educational, and sometimes administrative, functions.

Finally, as professional men became available, the appointment of State foresters under various departmental assignments brought in technical assistance.

At present 30 States have acknowledged public interest in their

forest resources by establishing in one form or other forest departments; but the function of the majority has so far remained an educational one; only a few have added the duty of administering the fire laws, and a very few have charge of State forests.

While 13 States now boast of State forests, with the exception of New York and Pennsylvania, Wisconsin and Michigan, the areas so set aside are nominal; the last two States with 400,000 and 277,000 acres, respectively, remaining not far from a nominal recognition of the policy of State forests. We all know how disappointing the development has shaped itself in New York State.

I may only quote from one who knew best: "Forest life in New York is apparently a melodrama; the actors, in some instances, are the creatures of stage managers, and change as the heads in Mexico, but we remain as unsettled as Mexico."

The utter incompetence so far shown by the Empire State in developing a rational policy, at least as regards State forests, has become notorious. The park idea, without economic conception, is still uppermost.

Perhaps the two forest schools which the State maintains may eventually be able to educate the people to a different attitude.

The only State that may be said to have developed a really businesslike forest policy and carried it practically to a tolerably worthy issue is Pennsylvania.

Having acquired around one million acres of State forest, it has provided a real organization of technical men for forest management on its holdings.

Yet even here we can not be sure of a systematic continuance of the policy of purchase, planting, and management. At least activity in the first direction has come to a standstill. And since under the law, the policy inaugurating the purchase of lands has specifically in view "the preservation of water supply at the sources of rivers of the State and the protection of the people and their property from destructive floods"—there is a possibility that the management for timber supply may at any time be considered outside the defined purpose and the matter be treated as in New York.

The States of the southern pine region, derive at present from their forest resource an annual product valued at over $300,000,000; they furnish half the lumber cut in the United States.

In view of the magnitude of these forest interests, the installation in four or five of these States of State foresters with a combined ap-

propriation which does not total $20,000 can only be looked upon as a sorry persiflage, entirely inadequate. It is not in disparagement of the efforts of the worthy men who act as State foresters that we pronounce this derogatory judgment regarding State forest policies, but merely to note the historic fact, that considering the importance of the interests involved, we are still only *puttering* with the problem.

Outside of providing in a manner for fire protection, the various State forest services, excepting Pennsylvania, have hardly passed beyond the stage of exercising educational functions; advising private owners, furnishing plant material, or planting themselves on a small scale; and managing small demonstration areas.

Perhaps we do not realize that the Eastern forests and forest lands —the absolute forest soils in the East—represent three to four-fifths of the total forest area of the country; they serve the largest contingent of the population, and their proper management for continuity is almost more important than that of the Western forests, for which the Federal government has made such good beginning.

The fact that these Eastern forests are practically altogether in the hands of private owners and can, therefore, become State forests only by purchase for hard cash, is sufficient explanation of the slow, almost negligible progress in this direction. Even if the desirability of a policy of State forests were clearly recognized, financial inability would in most cases be inimical to its adoption.

This leads to the inquiry how far the interests of the private owners may be relied upon to take care of these forest areas.

If we think of forestry as a management of forest properties under a sustained yield management, *i. e.,* for continuity, under a purposeful method of reproduction, we may claim that private forestry does not as yet exist. Some economies have been introduced in the exploitation of forests, conservative lumbering has been and is being practised here and there, small plantations have been made, more or less efficient protection against fire, with or without State aid, has been inaugurated. But it would be difficult to find any considerable tracts of privately owned timberland managed under anything that could be designated as a working plan for continuity.

We come here to the same expression as in the case of State policies, we are still merely "puttering" with the problem.

Nor can we expect much change. We may as well recognize now as later that forestry is in the main a business for the State, and only under very special conditions for private enterprise. The long time

element makes it so. Especially the wasted forest lands which can be recuperated for economic production only by planting—and these form or soon are going to form the bulk of the forest area of the Eastern States—offer no inducement, or only in rare cases, for private business. It is not because the profitableness of such an enterprise could not be theoretically proved, but practically the long wait for returns and the risks during that long term will deter a desire to invest money in this business on a large scale—such a scale as the needs of the nation at large require.

The financial aspects of private forest management have at this meeting most convincingly and in a painstaking manner with reference to actual conditions been discussed by Professor Kirkland, and I may not take up time to enlarge upon the subject, except to say that his ingenious way of organizing the lumbermen into a big trust for sustained yield management of their holdings does not promise speedy adoption.

With a few words I may make reference to municipal forests and woodlots.

In so far as public ownership of forests may be recognized as proper policy, the establishment of municipally owned—county, town, city—forest property is to be encouraged. At least a beginning in this direction is to be noted, 10 cities owning some 150,000 acres being on record.

It is, however, not likely that our larger problem will be taken care of by an extension of this quite proper policy. Nor will the farmers' woodlots, which are said to contain 10 per cent of the standing timber, even though they should be rationally managed, and in the aggregate represent a considerable accession to our wood supplies, solve the problem of rehabilitation of the vast area outside the farms.

What is needed is a still further extension of the federal policy as expressed in the Week's law. That law and Federal action in the purchase of watersheds was based on the claim of an influence of the forest cover on riverflow and the interstate interest in rivers which flow through several States.

The argument for national concern on the ground of influence on riverflow, as far as it is really valid, it will be admitted, can after all pertain only to limited territory, to localized conditions. On the other hand, there are far larger *nation-wide* economic interests in this forest problem which call for national action.

The whole nation is certainly concerned in the continuance of its

lumber supply; this is not a State interest, one that the single State can look after and control, not even an interstate concern for the Federal government to regulate, but a truly *national concern.*

And of similar national concern is the other, concomitant, economic condition, namely the rational use of the soils unfit for food production, of the thousands of square miles which are only fit for timber growing, and which under private exploitation have been or are being turned into wastes and deserts, thereby reducing the land assets of the nation. While in the first place the municipal corporation, town or county in which these wastes are located loses this property from the tax list, the prosperity of the State is, of course, also affected by such reduction of useful land, and finally that of the nation.

We have learned as a general political principle that the State should undertake only such work for the welfare of the community as the individual cannot undertake better or as well, and similarly we may extend this principle and call upon the nation at large when the single States by themselves cannot solve as well or better such economic problems, where the nation as a whole is concerned, and Federal action, or at least cooperation of Federal and State Governments, is called for. If continuity of a lumber supply and the recuperation of the waste acres is a national concern, as I believe it is, then such a cooperation should be called for.

It appears that most of the States are unable to undertake the solution of these problems on account of the financial burden it involves. Even the Pennsylvania State enterprise in forestry has come to a standstill on account of financial difficulties. Hence financial assistance on the part of the Federal government is the first requirement.

This assistance should, perhaps, take only the form of lending the Federal government's credit to a bonding scheme of the State for the acquisition of forest lands and their management. The financial result of such an enterprise, coming in a long future, such bonds should be of long terms and their issuance distributed over a considerable space of time as funds are required.

Cooperation would then further be required of the Federal government with the State government in controlling the expenditure of the funds, the selection of purchases, the making of working plans and their execution.

Finally, State legislation would be desirable by which private forest lands could come under State control not by purchase, but by contract

under an annual rental, participating in the returns of the larger and hence safer State forest management—cooperation between State and private forest owners—by which the latter profit in pooling their smaller interests with the larger.

While Professor Kirkland proposes the organization of a big trust outside of, and merely supervised by, the government, I propose a trust in which the government plays the large part and allows private owners to participate in a sustained yield management of the pooled properties.

There is little doubt, and the Pennsylvania experience seems to lend color to the belief, that such management, if placed on a large scale could from the start be made to furnish returns, and eventually to become as profitable as the German forest administration.

Perhaps this proposition may appear Utopian to you, but any one who has for the last 30 years watched the remarkable development of governmental activities, especially the broadening of functions of the general government, may believe even in the possibility of Utopia.

At any rate I for one believe that in a few years more the necessity of some such plan for solving our forestry problem will be recognized.

Our problem is one illustrated by the story of Sibylline books; when the larger number is burned, we shall be ready to buy them; when remedies have become more expensive, we will begin to apply them.

From this digression and far look into the future we may return to our survey of actual development.

In educational direction the progress since the early days has been phenomenal, following a period of slow development.

In popular education the American Forestry Association, originally and for a long time a small body without funds and kept alive only by the devoted effort of a small group, has lately grown to respectable numbers, satisfactory finances, and influential membership of a representative character. Some 30 more or less local associations complement the efforts of the national association.

Professional schools developed at first slowly. Until 1898 attempts to supply technical knowledge were confined to efforts of professors of botany or horticulture at agricultural colleges. The first professional school came into existence in 1898, at Cornell University, followed a year later by the one at Yale University.

Now, besides a number of privately endowed schools, nearly every State supports a forest school, and six States can boast of two State schools. Altogether some 52 institutions offer forestry courses, 23 of

them with two to five year curricula, leading to a degree, while some 40 run elementary or short courses.

There must be now well-nigh 5,000 students occupying themselves with the subject in one way or another. In 21 of the degree-conferring institutions alone over 3,500 students are enrolled for longer or shorter courses, and not less than 1,200 may be found working for a degree under the guidance of over 100 instructors.

From 22 of these institutions, by April, 1915, there had issued around 1,200 graduates, but less than 70 per cent of these, or more precisely 803, were engaged in strictly forestry lines.

It is evident the educational development is overdone except in so far as it may be claimed that a good forestry course furnishes as good a general education for life as any other university course; and moreover, it fits a man for a number of positions outside the regular line.

Eventually, it may be expected, the number of institutions giving a high-grade forestry education will be reduced and an increase of schools of lower grades for ranger service, which more than the high-grade schools need to be adapted to local conditions, will be found useful.

While there are a few ranger schools in existence, development in this direction is still desirable.

The earlier schools had to overcome the difficulty of lack of experienced teachers, lack of practical demonstrative objects, and lack of text-books. These difficulties have to some extent been removed, yet they still exist and the "eking-out" process will have to continue for a while, for forestry practice, especially silviculture, is still largely undeveloped, even in the administration of the National Forests. In this respect, again the State of Pennsylvania seems to have taken the lead.

Forestry practice is largely built on empiricism, and the accumulation of experience takes time.

Meanwhile, the modern more scientific spirit of attacking problems upon the basis of experiment and systematic investigation has made praiseworthy progress.

Within the last three years the Forest Service has systematized its investigatory work to an efficiency that rivals the work of the German and Austrian experiment stations (which had a start of 40 years), at least in plan, and may make these older investigators envious of the financial support which the Service can give to this work, from $300,000 to $400,000 being devoted to it.

So far, however, the accent in the investigations is still laid on the

forest products side—which at one time was not even held germane to forestry—and the silvicultural side is as yet not fully considered. Out of 162 listed problems nearly half are occupied with forest products and less than 30 with real forestry problems.

To my mind the most important knowledge we are lacking is how to solve the silvicultural problems for our species, for our soils and climatic conditions, for the reproduction of the timber we are cutting, and for the recuperation of our cut-over and wasted forest lands in the East as well as in the West. When we have learned this lesson, we may be justified in speaking of what the early pioneers talked of too prematurely as "American" forestry.

Meanwhile, a respectable literature has already accumulated: a large amount of information has been collected in bulletins and in the 14 volumes of the Forestry Quarterly, text-books are coming more and more rapidly into existence, and in this direction altogether a healthy development is to be noted.

Finally, I must not in this rapid survey forget to refer to ourselves, the Society of American Foresters and its members.

That with the first graduate from an American forestry school issuing in 1900—and that then the only one—it was possible to organize this Society in 1908 was, indeed, an unexpected feat. The Society has, however, not grown in numbers apace with the output of professional foresters, for it does not yet contain 30 per cent of the outturn.

In a manner its development reminds me of the early German professional society of foresters, which was started about 1795 and was to contain only noted foresters—those of "achievement." It was based on such a high plane that to get the essays of members printed in the official organ they had to pass four censors. That this "high-brow" society lasted at all in the then rather undeveloped state of the profession and science was due only to the indefatigable editor of the Proceedings, and with his death the long moribund society collapsed to make room very much later for a more democratic organization.

May we not profit from this example of the failure of a too high standard? While the latest attempt to democratize our Society has failed of acceptance, the vote on changed membership requirements allows the hope that soon the doors may be opened wider and a broadening of membership become possible.

The amalgamation of the aristocratic Proceedings with the democratic Forestry Quarterly may also contribute not to a lowering, but

to a broadening of standards in our magazine literature and eventually in the Society.

So far, as a Society we have not done much to advance forestry interests, but a new era in this respect promises to have begun with the work by the terminology committee, which has just completed its labors.

With this rapid survey of the situation, I hope to have shown that, while on the whole we can congratulate ourselves on our progress in the development of policies and professional direction, the situation as regards the problem of insuring a continuous timber supply to the nation, which is avowedly the main purpose of forestry, is by no means satisfactory or even hopeful.

In this respect we must learn to think nationally and develop a national policy, in which the Federal and State governments can cooperate.

In conclusion, may I make a suggestion of constructive character, namely, that the Society appoint a legislative committee to work out the details of such a scheme of Federal and State cooperation on practical lines and also that a committee be appointed to devise means of securing cooperation and coordination of investigatory work done or to be done by the various agencies engaged in research work.

CONTINUOUS FOREST PRODUCTION OF PRIVATELY OWNED TIMBERLANDS AS A SOLUTION OF THE ECONOMIC DIFFICULTIES OF THE LUMBER INDUSTRY

By Burt P. Kirkland

Professor of Forestry, University of Washington

Many of the brightest minds in this country have given attention in the last few years to the solution of the economic difficulties under which, it is well known, the lumber industry has been and still is suffering, but so far as I know, the placing of private lands under forest management has not been offered as any aid in the solution of these difficulties except in so far as the transfer of these lands to Federal and State ownership has been proposed. It is evident, then, that the person who attempts to attack this great problem along the latter lines has undertaken a large order. In approaching the solution of the lumber industry problems from the standpoint of permanent forest management, my purpose for the most part is not to draw specific conclusions, but to advocate a program of action which shall bring to the solution of forest industry problems such a body of coordinated scientific effort as has never heretofore been brought to bear.

Before proceeding to the consideration of a possible solution of these problems it is necessary to review them here briefly. The generally recognized ones are:

1. An overload of standing timber in private hands.

2. Over-investment in mills and logging camps.

3. As a result of over-investment in timber and in mills, a most destructive competition constantly waged, no let up on which is yet in sight.

4. Defective methods of distribution of forest products to the consumer.

5. Competition of substitutes.

Not so generally recognized are the following:

6. Excessive cost of capital, due to the industry depending upon speculative capital.

7. A heavy annual depletion charge against the industry, due to handling the timber as a mine instead of as a self-perpetuating resource as it should be.

Naturally enough, there are numerous minor evils affecting the

industry. It is held by many that taxation is a serious evil, but it is doubtful whether the lumber industry is taxed heavier than others relative to its importance. Tax studies from a different standpoint from any yet made must be had before anything definite can be said on this point. Those so far made are based on the assumption that forestry will always start with a bare tract, and that taxes must, therefore, accumulate for years at compound interest before income can be received from the investment. As such forest investment is entirely impracticable so far as attacking our forest problems effectively goes, it does not matter much whether our tax systems fit bare tract forestry or not.

The various problems will be taken up in the order named above.

1. *An overload of standing timber in private hands* (about 2200 billion feet b. m.).[1] This is most serious in the Pacific Northwest. At the Forest Industry Conference held in Portland, October 24–25, 1916, it was brought out that the supply of mature timber in private hands in the Pacific Northwest is sufficient to last nearly 100 years at the present rate of cutting. This condition arose from the over-liberal policy of the Federal Government, faithfully reflecting a public sentiment which, in the past, believed the national resources to be inexhaustible: that immediate development, regardless of rhyme, reason, or stability, was the thing to be had, and that it could be had best by immediate transfer to private ownership. Lumbermen and holders of timber in general are emphatically not to be blamed if they accepted the public invitation to take to satiety, almost free of charge. The taking went on until stopped in the period of from about 1895 to 1905 by the efforts of a small group of enthusiastic men—the conservationists—working to save a remnant of the public forests to be administered as National Forests on behalf of the public. The debt of the public to this small group has been reasonably well recognized. The enormous benefit to the lumber industry through saving it from this further enormous load of stumpage holding, and through the great increase in the value of western stumpage from 1900 to 1907, due quite largely to the removal of the 600 billion feet of National Forest timber from immediate competition with private, has not yet been recognized as it must be in the future. The transfer from public to private hands had continued until, at the present rate of cutting, in the neighborhood

[1] U. S. Dep't of Commerce and Labor. Bureau of Corporations, Part I, Report on Lumber Industry, p. 1.

of 50 to 60 years' supply of mature timber has been accumulated in private hands in the United States. This has led to a common current fallacy, namely, that because there is an excess supply of timber in private hands, there is also an excess national supply. If we, as a nation, are to keep our forests in condition to produce with undiminished volume, we have actually little if any excess national supply even now. The continuous production of saw timber demands large volumes of immature timber, always standing in the woods taking on growth, which can only be utilized for lumber after the stand is 50 to 100 years old or more. We have very little more volume of standing timber than we would need even if it were of the desirable young age classes.[2] Being mostly of old age classes, *far more volume must be in reserve* because a tree now of full maturity will serve little better to supply a given volume cut 60 years hence than a young tree containing no measurable volume now, but which will grow to full stature and be ready for cutting in 60 years. Our national reserve being in the unnecessarily old and large age classes, we must have more than we would need if an adequate volume of young age classes were available. We, of course, have some young timber—about 24 per cent of the Western Washington and Oregon National Forest area being under 60 years old, according to one authority,[3] but ultimately under forest management not over one-tenth of the forest area need be covered with mature timber at any one time. To have more is a disadvantage from the forestry standpoint, because it means unnecessary investment of capital and unnecessary expense, particularly through taxes. Of two forests under management for continuous production in the Pacific Northwest, of which one contains all mature timber and the other has a proper distribution of age classes, the former must have some 60,000 feet of taxable timber standing for each thousand feet that can be cut annually, while the latter needs not over 20,000 feet of taxable timber standing, and that of low value for each M feet annual cut. The same relations hold in regard to the capital invested. As long as the privately owned forests are operated by the timber mine policy, there will be an overload in private hands. No such condition, however, exists nationally, and that, therefore, no permanent national policy other than intelligent conservatism is thinkable. All discussion in this paper is based, then, on the

---

[2] See also article by the author, Vol. VII, No. 1, The Proceedings of the Society of American Foresters.

[3] Thornton T. Munger, in University of California Journal of Agriculture, November, 1916, p. 92.

idea that the only permanent solution to this problem will inevitably be one that includes keeping this forest resource continuously productive.

2. *An over-investment in mills and logging camps—i. e.*, in the forest utilization end of forest industry.

At the recent Forest Industry Conference in Portland, Oregon, already cited, it was brought out that the ten-hour operating capacity of sawmills capable of operating is at least 60 to 75 per cent greater than the market requirements demand.[4]

What do these figures mean? They mean that the average sawmill and logging camp in the United States cannot operate more than two-thirds of the time. They mean that from the average investor's standpoint, at least one-third of the capital put in sawmills and logging camps has been wasted, and from the public standpoint that one-third of the investment was unnecessary to supply needed product. Since the capital invested in this field, according to the 1914 census, is over $916,000,000, these figures mean that over $300,000,000 was invested unnecessarily in this portion of the industry unless it be necessary to maintain an excess of investment of this size in order to maintain the time honored system of competition. These figures, in fact, represent the cost of competition.

An easy check on these figures can be had by considering how much capital would be necessary to construct and equip camps and mills sufficient to supply the entire present market, if all the present camps, mills and equipment were wiped out. Considering the present annual demand to be 40 billion feet b. m., and that there can be 300 days of operation each year, it appears that about 134,000 M feet b. m. must be manufactured daily to supply the market. No excess capacity is needed to supply seasonal demand, because lumber can be easily stored from season to season. In most regions, mills can operate throughout the year, though in a few localities logging may have to shut down at some seasons. Assuming that mills of efficient size are built, $3,500 is considered an ample sum to construct and equip camp and mill capacity sufficient to turn out each 1,000 feet b. m. daily. Hence, to turn out 134,000 M feet daily, 134,000 × $3,500 = $469,000,000, the amount necessary. These figures assume that the mills built shall be of the most efficient, electrically operated type. The average existing type is more cheaply built. By this method the over-investment indicated is close to $450,000,000, but in order to be conservative I shall use the

[4] West Coast Lumberman, November 1, 1916, p. 34.

lower figure of $300,000,000 in this discussion when speaking of investment only useful to preserve highly competitive conditions.

3. *Destructive competition.*—As a result of the competitive system under which capital is continually rushing into those industries which *seem* to promise large and quick returns, in undue amounts, while those that give small or distant returns (such as forest production) are neglected, the results in over-investment we have just discussed have been secured for the lumber industry. The stumpage overload has come within perhaps the past 10 years to aggravate this condition, and its influence in the future, if unchecked, bids fair to be far more disastrous than any influence to date. This follows because the higher the value of the timber becomes, the higher the taxes and other charges mount, so that cutting becomes a more and more urgent necessity, and the competition keener and keener. Whatever the benefits, if any, to be derived from competition in other industries, it is clear enough that here it only results in early destruction of an essential resource.

These figures of over-investment can be reduced to figures of annual cost with a fair degree of accuracy. Three elements are involved, interest, maintenance and depreciation. Where this capital was borrowed by the lumberman he paid 6½ per cent or more, but assuming it is worth only 5 per cent interest, the annual interest charge on this investment for purposes of competition only is $15,000,000. Maintenance of the investment (all of which, one must remember, has been embodied in mills, camps and equipment) cannot be so definitely estimated, but can certainly not be under another 5 per cent, or $15,000,000 for the whole excess investment. In spite of any amount spent on maintenance the item of depreciation still remains. In the lumber industry there is so much temporary construction, and machinery depreciates so rapidly, that the total depreciation rate is high. Ten per cent may be considered a very conservative average figure. If so, the annual charge on $300,000,000 must be $30,000,000. The total annual cost of the three is $60,000,000. This means a charge of over $1.50 for each 1,000 feet of timber cut annually in the United States. This figure is, of course, not accurate, but it appears extremely conservative. I shall refer to it hereafter in this discussion as the "cost of competition."

If an individual needing two mills should build three, two to operate and one to be idle, he would be branded as unwise, and his bank credit perhaps injured, all of which shows that individually we should not under any circumstances knowingly commit practices which collectively we have not learned to avoid. In fact, a large majority of the

American people, including many in influential quarters, are, as yet, enthusiastic supporters of the industrial system of building three or four plants where two are needed. This system is called by its supporters "healthy competition," but in my judgment the term is incorrectly applied. "Healthy competition" properly applied will upbuild the forces of the individual, and improve industrial processes, but I do not concede that such waste as is here indicated is a necessary adjunct, provided we can apply collective intelligence to this problem. The term "destructive competition" is more definitely descriptive.

I do not question that competition was an acceptable process in the days of very small-scale manufacture. Capital was then scarce and would not be invested except on a good chance of getting returns. Transportation of product to a great distance was rare, and the market being of small scope was easily estimated in advance and over-investment seldom resulted. Moreover, the failure of a small plant produced no greater social disturbance than does the failure of a farm, or small retail establishment today. Only a few individuals were affected, and the labor involved easily found employment in the same locality.

The relative abundance of capital today, and its enormous outturn in product in the modern industrial plant, puts quite another face on the problem. We must have a care here, or modern industry will destroy as much capital as its enlarged facilities for production can create. It seems probable that here is one of the important reasons why, with the enlarged means of production and abundant resources everywhere at hand, we have not been able to increase the general standard of living as everyone agrees we should. Instead of using the increased product of modern industry for consumption, we have put it back into machines and plants we cannot use. Then, having saddled these unnecessary plants on industry we must constantly spend additional capital in maintaining what we have created. The result is that the human factors in production, both employer and employe, have to spend so much time in maintaining the industrial establishment that relatively little time is left in which to produce goods for consumption. After goods have been produced the persons in other industries cannot buy them because the lion's share of their effort must also go to maintain their own industrial machine.

Effect of Over-Investment in Lumber Industry on Investors Concerned.

The first effect of over-investment is, as has been seen, creation of a manufacturing capacity beyond what the market will absorb, at least at remunerative prices. Under competition surplus mill capacity

is almost immediately followed by price cutting. The first results of a period of price cutting are of course a gradual narrowing of profits. Since some plants are always in a state of barely making profits, they are soon forced into a losing position. Still further price reductions will bring all but the most efficient to this condition.

Its effect may not be extremely serious until a point is reached where sales are made at less than cost of production, not at all a rare condition when depreciation is taken into account as a cost. This is the point where the investor's capital not only fails to give returns but actually begins to slip from his grasp. The physical deterioration of his plant goes on whether he operates or not. It goes on, in fact, at all times both in prosperity and depression, but in low-price periods, if he operates, a sufficient return does not come back from the sale of product to replace this lost capital. This means that his capital is gradually being transferred to the purchaser of lumber without compensation. If he does not operate physical deterioration goes on just the same without being reflected in creation of product, which means that his capital is lost not only to himself but to the world. That is the destiny of the $60,000,000 or more annual cost of competition. It is only a portion of the losses to the investor. Whenever prices get below cost of production, including depreciation and interest, there is no escape from loss either in operating or lying idle.

Price cutting, then, if carried far enough, results either in transferring capital from the investor to the consumer of forest products or in the absolute destruction of capital. Where this is going on the industry is obviously in a depressed condition, and investors are no longer attracted to it. As a consequence the invested capital gradually shrinks in amount. Physical evidence of this is seen in the deterioration of many plants till some are no longer susceptible of profitable repair. This shrinkage of the capital invested tends to restore normal conditions as to output and remove the reason for price cutting, so that in time prices begin to recover. Since investors are apt still to be wary of such investments, this recovery may proceed so far as to bring about abnormally high prices, but in the lumber industry the overload of investment in the timber which cannot be cut for years to come results in building mills not called for by market conditions and, hence, in delayed recovery of the market. Moreover, such periods of prosperity as may come may be expected to be short on account of this overload of stumpage investment.

However, though recovery may be delayed it is inevitable eventually,

not only to the point of fair prices but to the point of high prices. These are reflected in high earnings of such capital as remains in the industry. *But these high earnings cannot be continued under competition, because over-investment will again certainly be induced and the cycle just described again repeated.*

This alternative attraction and repulse of capital coincides with periods of prosperity and depression in the industry. An industry organized on the basis of extreme competition as the timber industry is must continually go through these cycles. Alternate periods of prosperity and depression are inevitable, because prosperity of the industry leads directly to over-investment of capital and hence to a condition where every dollar invested is ready to beat every other dollar over the head.

It is necessary to consider competition also from the standpoint of continuous production from our forests. From the forestry standpoint, continuous production means literally that each forest shall be made to produce continuously from year to year. In order to take advantage of favorable prices, the cutting may and should be speeded up in prosperous times, but this speeding up must be compensated for in dull times. To go any further toward periodic yield renders the enterprise financially impracticable to the average forest owner. These facts being admitted, it is at once apparent that, from the *forestry standpoint, destructive competition begins when more mills are built in any forest producing unit than the unit will support permanently.* The competition here results in the waste of capital put into the unnecessary mill and, *still worse, the destruction of the forest which formed the basis of the industry.* Why? Simply because when the forest or any other resource ceases to yield revenue the owner loses interest in it. It is then left to the mercy of the elements. Some resources can withstand this treatment, but we know only too well what fire does to the forest. If we wish to keep the forest resource in productive condition, then the standard amount of mill construction for any given producing unit is that amount which will utilize continuously the full product of the forests in that unit. There are unimportant cases where small forest tracts will support a mill for only a short time. Here the portable mill or temporary structure is indicated. As these types are so inefficient in operation a better solution in most of these cases is to ship the logs to the more efficient permanent plants. The practicability of this is proven by experience of the Pacific Northwest, where logs are regularly transported 50 miles and more by rail on common-carrier railroads. American forest

industry has never accepted any such standards of need in mill construction. Instead the forest has been destroyed by unnecessary plant duplication at the same time the profits of the industry have been wiped out. Dr. Fernow well describes what happened under this policy in the Lake States:

"In 1868 the golden age of lumbering had arrived in Michigan; in 1871 rafts filled the Wisconsin; in 1875 Eau Claire had 30, Marathon 30, and Fond du Lac 20 sawmills, now all gone; and mills at LaCrosse which were cutting millions of feet annually are now closed. By 1882 the Saginaw Valley had reached the climax of its production and the lumber industry of the great Northwest, with a cut of 8 billion feet of white pine alone, was in full blast. The white pine production reached its maximum in 1890 with 8½ billion feet, then to decrease gradually but steadily to half that cut in 1908."[5]

What is the result today? A recent report of the Wisconsin Agricultural College[6] states that Wisconsin has 10,000,000 acres of cut over lands of which three-fourths may be agricultural. Only 50,000 acres is being cleared annually. A 150 years' job at the present rate! This shows conclusively that whether the land once occupied by forest is agricultural or not, there would have been time to raise from 1 to 3 more forest crops before agriculture could take possession. In fact, agriculture would have taken possession much faster if its natural markets had not been destroyed by destruction of the forest. The care of this forest area and continuous utilization of the product would have kept an enormous number of workers and their hangers-on continuously present in close proximity to the agricultural land. This creates the best of all markets where the producer deals directly or almost directly with the consumer without the intervention of the transportation company and too many middle men. If 7½ million of these acres had been kept in forest, even the low average growth of 300 feet b. m. per acre would have produced 2¼ billion feet of lumber annually. It is said in the Pacific Northwest that every 1,000 feet of timber taken from the forest involves the payment of $8 for wages and supplies. If a like ratio applies in Wisconsin the annual product mentioned would have involved the annual payment of $18,000,000 for these purposes. Much of this would have gone to the settler for food products and eventually furnished the land clearing fund which must now be painfully

[5] Fernow's History of Forestry, p. 472.

[6] Report on land clearing demonstration trains conducted through northern Wisconsin in May, June, and August, by Wisconsin College of Agriculture.

brought from outside. It is unnecessary to add that the presence of forest industry would have furnished unfailing support through employment of the settler when his farm failed to do so.

The production of this new forest crop, at the same time, would have decreased not at all the output from the stand nature provided. The farmer of the plains would, therefore, not have been deprived of his cheap structural material. Such a policy would have utilized part of the capital which moved on to the West to invest in standing timber which can go on the market no sooner than the new crop from these Wisconsin lands would have been ready to cut. We have, in part, destructive competition—mill construction far in excess of needs—to thank for these conditions in Wisconsin.

Shall we pursue the same policy and get the same result in the South and Pacific Northwest? Not if we can in time realize the tremendous productive possibilities of the forest and permit or, if necessary, require such industrial organizations as will utilize these possibilities. It is obvious enough that limitation of the yield of forests in a given region to what they will continuously produce also automatically limits flooding of the market with forest products. This constitutes the only sound and permanent method of maintaining fair prices during that period in each region when seemingly unlimited mature timber is ready for cutting. Later, under the timber mine policy, regional supplies become exhausted and prices go to great heights because of the distance which timber brought in from other regions has to be transported. Under a forest policy, then, prices are maintained while there is an overstock of mature timber and held down to reasonable levels later on, when otherwise the freight charge alone is in excess of the necessary stumpage charge under forestry.

4. *Defective methods of distribution.*—There is good reason to believe that in this field the wastes are as great as in the producing field, but as these wastes are apparently not reducible to actual figures, so far as any investigation so far made will allow, no estimate can be made as to the actual cost. The wastes here include unnecessary duplication of yards, duplication in selling, and general lack of organization from producer to consumer. Here, again, is a field for careful discrimination as between organizations. It may be that we need to encourage organization of the producer on the one hand and the consumer on the other, in order that they may reach out to each other and effect the transfer of goods as cheaply as possible. Where such organization is assisting in the cheapening of the distributive process, well and good;

where it is operating to increase the spread between the price the producer gets and what the consumer pays, the benefits of organization seem doubtful from the public standpoint.

Another serious defect in the field of distribution is the serious lack of consumer's education in the use of wood. He has been weaned away from the use of wood by aggressive advertising, which in some cases has resulted in substituting less economic materials for wood. So long as the public fails to give impartial education in the use of materials, through the schools and other means, which would enable the public to know which is the most economic material for a given need, it is obviously necessary for the lumber industry to educate the public through advertising.

5. *Competition of substitutes.*—The U. S. Forest Service is authority for the statement that substitutes have displaced wood to the extent of at least 8 billion feet b. m. per annum. Great as this loss to the industry is, it may not be an economic loss to the community as in the case of the cost of competition. If the substitutes better serve the purpose at no greater cost, then the community is benefited; otherwise, not. There is no doubt that, although some of them serve better, many are less serviceable. This is, however, a point which space does not permit to discuss here at length.

Great as this competition may now be, it has probably only started. The increased capacity of steel plants resulting from war's demands will leave them with tremendous surplus capacity when these demands cease. Since these concerns have unlimited capital and complete organization to oppose against disorganization in the lumber industry, the results of this future competition bid fair to be disastrous. It is, for example, entirely possible to put on the market small standardized buildings for farm purposes, built of standard steel shapes and corrugated iron. These buildings would, of course, be most susceptible to interior fires and shorter lived than wood buildings, because rust in small members acts more rapidly than decay in properly constructed wood buildings, yet they will no doubt be claimed to be both fireproof and absolutely permanent. Can the public afford to let an industry based on a resource, use of which leads eventually to its complete destruction (as steel is based on iron and coal resources even if that destruction be long delayed), destroy another great industry which is based on a perpetually renewable resource as the forests? It must be borne in mind that the forests are not only renewable, but may without appreciable expense be made continually more productive by the mere selec-

tion of proper species and the intelligent use of the ax. These two agencies constantly improve the soil itself without the addition of artificial fertilizers. It must also be remembered that our two other great perpetually productive resources, the agricultural soil and water powers, are at many points dependent on the forests. In the long run there is little doubt that the steel industry, itself, would suffer most seriously from discontinuance or serious damage to the lumber industry. Although a competitor, the lumber industry is at the same time a great consumer of steel.

The simple fact is that for every resource we leave unused we decrease the ability of our country to support population. We thus fail to that extent to create a demand for the products of other industries, all of which suffer by the lack of demand for their products. The forest resource already supports directly probably not less than 3,000,000 persons, including workers and their families directly dependent on the lumber industry. No one knows how many merchants and middlemen and all sorts of trades are dependent on the industry. It also supports, probably into the millions more, those engaged in pulp and other forest industries. Yet wood is a product which can be grown in larger quantity than we now use on land useful for little else. This resource can be made to support a much larger population than it does now and hence furnish a much larger market for other industries than it does today.

6. *Excessive cost of capital.*—W. B. Greeley, at the Portland conference, showed that the industry is paying 6½ per cent or more for borrowed capital and that from 30 to 50 per cent of the capital is borrowed. If 6½ per cent is the interest charge, the total cost, considering underwriting fees and cost of appraisal, cannot be less than 7 per cent. The per cent of capital borrowed is by no means excessive, providing the industry can pay the interest rates. As it is, I believe, well established that the industry is earning less than 3 per cent, at least in many regions, it is evident that the position of the business man who pays 7 per cent is untenable, unless his borrowings are very small, but this latter is a condition we should not expect or desire. It is the function of the business man to take the capital of those who are unable to take direct part in the organization and management of industry and make it productive. When this process ceases the community stagnates and capital brings no return. The business man cannot be expected to perform this function unless he can make a profit on the capital borrowed.

The question here is, why these high interest charges? The answer is that the capital borrowed is of a semi-speculative character. I am not using speculative here or later in this discussion as a term of reproach. I am well aware that speculative capital has assisted the pioneer in conquering the wilderness, pioneered all our new industries, and largely built our railroads. In old, established industries like the lumber industry we should, however, not be dependent on this class of capital. They should rather be financed by conservative investment capital and let the speculative capital move on to new business adventures. By conservative investment capital is meant that of savings banks, insurance companies, and some individually owned capital. Why is this class of capital not put in the lumber industry? Because, in the first place, the borrowing of the forest industry is not organized on a large scale; any one issue of securities is not large enough to attract attention in the money markets of the world or even the United States, and hence can never attain a position of marketability such as the great railroad bond issues have. In the second place, the public has not recognized the right of forest industry to earn stable income nor any effective right to organize for betterment of its condition.

Early railroads in the United States were financed in a highly speculative manner. They have gradually moved toward an investment basis. Today they do not figure in spectacular stock market operations partly for that reason. The speculator does not see a prospect of fluctuations on the basis of which he may win profits. Consequently, he leaves these, both railroad stocks and bonds, to the investor. It is true, the investor is still shy of certain railroad properties which from past mismanagement or from unfavorable location in regard to traffic are not showing absolute certainty of adequate earnings. The constant effort both of railroad managers and public regulative bodies backed by public opinion is to put these remaining properties on a sure earning basis. This done, practically all railroad capital will be furnished by the investor, once he is convinced that the public is educated to the necessity of allowing adequate earnings. In return for this attitude on the part of the public, the investor will be willing to furnish railroad capital at a rate of, perhaps, 4 per cent on the bonds and to 6 per cent on the stock.

The lumber industry is far older in America than the railroad industry, but, unlike the latter, the advantages of large-scale organization have not been so obvious nor the wastes of destructive competition so clear. However, the waste of constructing two parallel railroad

lines to serve the same territory differs only in degree from waste of two retail yards serving one small town, or two mills to cut the timber from a tract from which one could cut the timber. In the case of the parallel railroad lines, the unnecessary retail yard, and the unnecessary mill, the waste as to the original capital expended is alike complete. We have ceased building the parallel railroad line and recognize the right to fair railroad earnings. As a reward, capital is willing to work on a conservative investment basis. This reduces the cost of the service to us of the $16,000,000,000 of capital required, by hundreds of millions annually under the cost of speculative capital.

When we acquire even that imperfect degree of wisdom in regard to forest industry that we have in regard to the railroads, the public will be willing to let the industry organize to save the cost of competition. When that is done, the conservative investor will know that here is a safe investment field and will be willing to furnish the borrowed capital needed at 4 to 5 per cent interest. The conservative investor will be benefitted by this new large field, while speculative capital need not suffer, because it can move on to serve the public in new untried fields at home and to the conquest of the tropics. At the same time, the savings to this industry and through it to the public, should be enormous. According to the Department of Commerce, the investment in standing timber in private hands in this country is not less than $6,000,000,000,[7] while, as we have seen the investment in the logging camps and sawmills is nearly $1,000,000,000, a total of $7,000,000,000 without including the distribution end of the industry. We should, as an ultimate goal, if intelligence is used in organization of credit, look forward to securing 40 to 60 per cent of this capital on an investment basis of 4 to 5 per cent. This means 2 to 2½ per cent under the present cost of capital. This would mean on $3,000,000,000 of borrowing an annual saving of $60,000,000 to $75,000,000. This is not necessarily a loss to the lender. It means, rather, that his losses of capital having been eliminated, the average interest rate he can loan under are less.

These statements may seem overdrawn, and that these reasonable interest rates are impossible. This is without doubt absolutely true, so long as forest industry is organized as at present. If we cannot secure cheaper capital, private forest management is impossible and only such of our forest resources as the Federal Government and States can rescue in time can be saved. Forestry will not yield over 5 per cent

[7] Department of Commerce and Labor, The Lumber Industry, Part I, p. 19.

and, as has been pointed out, the position of the business man who must borrow at 7 per cent to operate an industry which earns 5 per cent or less is untenable.

The holding of timber for increases in value is still more untenable under the high interest charges. The per cent earned by holding is probably not above 3 per cent at the present time and must almost inevitably sink to under 1 per cent in the course of time. (See Table 1.) Thus, here again, either cheaper money must be had or the government must step in and take over the timber, otherwise the forest will be looted of its best and the rest left to be destroyed by fire or what not. It may be considered impossible for the government to step in to the tune of $6,000,000,000 in any short space of time. It seems to be, further, most undesirable. There is, in my judgment, only one practicable and reasonably quick solution to this problem and that is to allow complete organization of the industry through which lumbermen are fully competent to solve their own problems. This will save the public general taxation to conserve this resource and make unnecessary another large corps of government investigators and regulators of industry, such as seems to be necessary in agriculture.

This question is also related to the problem of remuneration to labor. So long as we insist on the maintenance of present small-scale organization in industry, which carries with it this unnecessary interest charge of $60,000,000 and the destructive competition charge of at least an equal amount, both capital charges, we are making it necessary that these charges shall be added to property income in order to maintain the capital of the industry. Hence, either the public or labor or both must share this loss between them. Just what proportion of the loss each bears it is impossible to say, but the share of labor must be large. This means less purchasing power and a lower standard of living. Insofar as the purchasing power is lowered the market for the products of other industries, especially those producing goods for immediate consumption is decreased. Right here is where every other industry has vitally affected interests at stake in seeing to it that forest industry is so organized as to divert these wastes of capital to productive expenditure either by capital or labor.

It further may be seriously questioned whether the saving, in this and other industries, of the capital wastes we are here considering, will not, in the future, be the surest means of market extension for all industries. The limit of market extension through these means falls not far short of the total ability of labor to produce and the consumer

to consume. By this standard it is doubtful whether the market for any important product has been 50 per cent developed.

7. *Depletion charge on the forest resource itself.* If our 2,200 billion feet of timber in private ownership continues to be worked on a mine basis it will last, assuming that timber of a character for lumber manufacture is all used for that purpose, at the present rate of about 40 billion feet per annum, in the neighborhood of 50 to 60 years. If we assume that some of our numerous wood products are taken from saw timber forests they would be exhausted quicker. But, in order to make a conservative estimate let us take 55 years as the time. This means that 1/55 of the present mature timber is cut and removed annually. If forests were worked under continuous yield they would stand this annual cut indefinitely. That is, the capital would remain intact; but as they are worked like a mine, they are being depleted by this amount each year. That is to say, the percentage rate of depletion is in the neighborhood of 1.8 per cent as far as volume goes. Up to date, the increases in stumpage value have in money values overcome this depletion. Eventually, however, the entire capital will be removed from the forest by these methods. On the average approximately the depletion rate of 1.8 per cent of the values today must be applied to the forest investment, just as certain depreciation rates must be applied to the mill and logging camp investment.

One and eight-tenths per cent of $6,000,000,000, the Department of Commerce estimate of privately owned timber value, gives $108,000,000 as the annual depletion charge. This can nearly all be saved by placing these lands under continuous forest production. This latter step costs money, though not the great sums sometimes stated. On the basis of figures for the Pacific Northwest, a safe estimate seems to be that for the nation the total annual cost of regenerating mainly by natural means, protecting and administering all lands annually cut over would not exceed $2,000,000, the first year (if this policy were applied everywhere at once) and even in 20 years would not have mounted to annual cost of over $7,000,000, really insignificant in comparison with the annual cost of competition or the cost of speculative capital and a mere nothing beside the depletion charge itself.

Under present policies timber owning companies are too often paying dividends (if any) out of capital (the wood capital). A policy of forestry for continuous production would put an immediate stop to this bad business practice. The dividends would be temporarily lower but the capital would be conserved. This problem is somewhat complicated.

It seems obvious that it is good business to save $108,000,000 at an expenditure of less than $7,000,000, but the question arises whether the industry today can profit by this. It must be concluded that it can; that this depletion charge is a real charge on the industry as a whole and its saving is a saving to the industry as a whole. It is saved because this future capital (the forest) that will be maintained in producing condition, as a result of these small annual expenditures for protection, taxes and administration of the cut over lands, can be definitely discounted to present value, just as a government bond due 50 years hence has a present value.

It must, however, be admitted that although placing the forest on a basis of continuous production will unquestionably pay better in the future than the timber mine policy, because it adds a return from continuous use of the forest to the return from increase in stumpage value at the same time the depletion charge is saved; still the percentage return from the forest investment cannot be excepted to be much above 3 to 5 per cent all told. Since, as has already been stated the position of the business man is untenable who attempts to operate a 3 to 5 per cent investment on 7 per cent capital, this brings us again to the absolute necessity of cheaper capital on forest industry. If we do not get it what will happen? Liquidation is the answer. The capital value must shrink until the income pays the higher interest charge on a lower capitalization.

There are those who think that this shrinkage of capitalization of the timber is inevitable and not a few who think it desirable on the ground that the present values are "speculative" and the speculator should be destroyed. Is this the correct view? I think not. Passing over the fact that this shrinkage of value would jeopardize many a timber bond issue and bring other ills on the investor, it is very easy to show that it will be injurious to the public. Why? Because low value means lack of care of the resource and wastefulness in its use. Timber, magnificent as it is, in the Pacific Northwest was not considered worth protecting till after the rapid rise in values ending about 1907. Since that time the present splendid protective system has been built up. It will be a public injury to have any slump in these values followed by decrease in the protective expenditures. Likewise, so long as timber is cheap only the cream of it is taken from the woods. The rest remains to be destroyed by fire. Until about 1900 all the hemlock, an abundant species in the Northwest, was so left in the woods. I see no way to maintain these values unless the expense of holding the timber can be

cut down by lower interest rates. For a time owners may be expected to hold on to investments earning lower rates than their capital would earn elsewhere, but in the end they will withdraw their capital as best they may and put it elsewhere. The holding of the timber land and keeping it under continuous production would be a justifiable investment if two conditions are met, viz., cheap capital to hold the timber with and good returns from manufacture of it when cut.

Forests properly handled produce continuous yield. Their capital value under these conditions suffers no decline with time but on the contrary constantly increases because within modern times all civilized countries have shown constant increase in timber values. When the wood capital of a forest is handled like a store of minerals the finance and economics of the forest becomes identical with that of the mine. Since with the exception of the farm woodlots and some of the New England forests, practically all our private forests are handled on the timber mine basis, our prevailing ideas of forest finance and economics even in the case of professional foresters are adapted to that mode of management. Only a few have been able to conceive of the forest as a living, growing thing which can be made to furnish continuous product. When we have thought of it as yielding growth we have been unable to visualize the forest organized to give returns every year. As a consequence we think nearly always of forestry as starting with a bare tract. Under such conditions the forest becomes an expense account for 50 years or more. Such an investment in a large way is wholly impracticable for private enterprise and even for public enterprise if we expect to deal with our vast forest problem effectively. Wealthy and thickly populated France appears to have planted up in the course of more than a century some 5,000,000 acres, the state, communes and private owners all working together. The State of Washington alone at its present rate of cutting will log off this amount in twenty years. If the forest is completely wrecked in this process, as is the general rule, a century will not suffice to repair the loss, but the forest problem of the State of Washington is only a small item in the total problem of the nation.

The truth is that the only effective way to save this resource is to keep the forests we have producing continuously, that is, start our forestry with and while we have the forest. Under these conditions the forest yields annual revenue from which all expense of taxes, protection and regeneration may be met. It has been conceded, however, that even then the forest will yield only 3 to 5 per cent on the investment from current returns. The percentage relation between the capital

invested in the forest consisting as it does mostly of standing timber of the same nature as the annual product and similarly valued (except by difference in maturity), to the product, prevent its yielding more. Therefore, we must again conclude that cheap capital is an absolute essential to put the forest owner in a position to practice forestry permanently. Occasionally forestry may yield more when increase in value of the whole investment is added to the current return.

Four problems must then be solved: First, there must be consolidation of the ownership of forest lands into efficient producing units. Second, there comes their physical organization to provide for annual returns form each unit. Foresters have been known to scoff at this matter of organization for annual returns, but the financier will see at once that without it financing will be impracticable. The third problem has to do with the business organization of the enterprise. Forestry requires stable policies of management over long periods of years, such as frequent changes of individual ownership can never provide. Outside the farm woodlot the large corporation is the only form which gives any promise of successful private forestry. Proper physical organization of the forest under corporate ownership should give the corporate securities a safe annual return. They will differ, then, not at all from the railroad investment so far as income goes providing of course their ability and right to earn adequate dividends is recognized. Under these conditions the securities become marketable and may change hands from time to time without disturbance of the management of the enterprise. But to realize this consummation the fourth requirement of cheap capital must again be emphasized.

Will the Forest Yield More Financially under Private Ownership when Handled as a Timber Mine or when Handled for Continuous Yield?

The mine can yield its store of mineral but once, so that it can only return the capital invested in it plus or minus any increase or decrease which has taken place in the value of the capital. When timber is handled by the mine policy, it is subject to the same conditions as a mineral resource. It is unnecessary to handle the forest in this manner, however, for it is capable of giving three main kinds of increase in value, viz:

Increase in price (due to increase in demand as related to the supply).

$\left.\begin{array}{l}\text{Increase in volume}\\ \text{Increase in quality}\end{array}\right\}$ (due to timber growth).

Heretofore, in America, we have depended solely on the first for return on timber investments. The question is, can we expect this element alone to yield a satisfactory return in the future or will it be necessary to *get two returns from the forest—one a current return from the growth, the other the increase in value of the property as a whole, which takes place as stumpage values increase in a forest under management just the same as they do in one held only for the purpose of increase in value?*

Theory of Speculation in Natural Resources

In the past, vast fortunes have been made in America by buying in natural resources when they were cheap and holding without making any use of them until they had increased in price. Standing timber is only one example of a natural resource used in this way. The question is, can large returns be secured in this manner in the future? The evidence is against this assumption. The problem is, in fact, one of simple mathematics. *In order to yield a satisfactory interest return by increases in value these increases must be at a geometric rate more rapid than the compound interest rate under which the investor is willing to work.* This is true because there are constant charges for taxes and other expenses which must be met. The annual rate of increase must continually become greater as the value becomes greater. But, in fact, nothing of the sort ordinarily occurs. Increases in value go on at an arithmetic rate which at first makes a satisfactory return on the investment, but later does not. To take timber, as an example, statistical inquiries in the Pacific Northwest show that during the 25 years preceding 1916, stumpage values increased at an average rate of about 10 cents per M feet per annum.[8] There is no evidence to show that they are increasing faster now. On the contrary, there is reason on the part of owners to fear that they will not increase so rapidly or may for some time remain stationary. But even assuming they continue to increase at the same rate as in the past they will not give a satisfactory interest return in future.

Table 1 is designed to show approximately what these increases have meant in interest returns in the past and what they will mean in the future if the rate of increase continues. This rate, it should be stated, did not move forward smoothly throughout the period involved but rapidly at some periods and slowly at others but the averages must be much as shown in the table.

[8] See Forest Club Annual, University of Wesleyan, 1916.

TABLE 1.—*Interest Rates Accruing to Holders of Douglas Fir Stumpage in Pacific Northwest at Various Periods of Holding*

Dates	Values year by year when the total increase of period is distributed as annual average	Taxes 1 per cent of actual value	Adminis-tration and protection	Total carrying costs	Net increase in value to owner	Per cent made by net increase in value on value of previous year (re-turn on capital invested)
		Cents	*Cents*	*Cents*	*Cents*	*Per cent*
1892	$.10	.1	.3	.4	9.6	96.0
1893	.20	.2	.3	.5	9.5	47.5
1894	.30	.3	.3	.6	9.4	31.3
1895	.40	.4	.3	.7	9.3	23.2
1896	.50	.5	.3	.8	9.2	18.4
1897	.60	.6	.3	.9	9.1	15.1
1898	.70	.7	.3	1.0	9.0	12.8
1899	.80	.8	.3	1.1	8.9	11.1
1900	.90	.9	.3	1.2	8.8	9.7
1901	1.00	1.0	.4	1.4	8.6	8.6
1902	1.10	1.1	.4	1.5	8.5	7.7
1903	1.20	1.2	.4	1.6	8.4	7.0
1904	1.30	1.3	.5	1.8	8.2	6.3
1905	1.40	1.4	.5	1.9	8.1	5.8
1906	1.50	1.5	.5	2.0	8.0	5.3
1907	1.60	1.6	.7	2.3	7.7	4.8
1908	1.70	1.7	.7	2.4	7.6	4.4
1909	1.80	1.8	.7	2.5	7.5	4.2
1910	1.90	1.9	.7	2.6	7.4	3.9
1911	2.00	2.0	1.0	3.0	7.0	3.5
1912	2.10	2.1	1.0	3.1	6.9	3.3
1913	2.20	2.2	1.0	3.2	6.8	3.1
1914	2.30	2.3	1.0	3.3	6.7	2.9
1915	2.40	2.4	1.0	3.4	6.6	2.7
1916	2.50	2.5	1.0	3.5	6.5	2.6

If increase of 10 cents per M per year is assumed to continue, the following will be the approximate financial results.

1917	2.60	2.6	1.0	3.6	6.4	2.5
1918	2.70	2.7	1.0	3.7	6.3	2.4
1919	2.80	2.8	1.0	3.8	6.2	2.2
1920	2.90	2.9	1.0	3.9	6.1	2.1
1921	3.00	3.0	1.0	4.0	6.0	2.0
1922	3.10	3.1	1.0	4.1	5.9	1.9
1923	3.20	3.2	1.0	4.2	5.8	1.8
1924	3.30	3.3	1.0	4.3	5.7	1.7
1925	3.40	3.4	1.0	4.4	5.6	1.6
1926	3.50	3.5	1.0	4.5	5.5	1.5
1927	3.60	3.6	1.0	4.6	5.4	1.5
1928	3.70	3.7	1.0	4.7	5.3	1.4
1929	3.80	3.8	1.0	4.8	5.2	1.3
1930	3.90	3.9	1.0	4.9	5.1	1.3
1931	4.00	4.0	1.0	5.0	5.0	1.2
1932	4.10	4.1	1.0	5.1	4.9	1.2
9933	4.20	4.2	1.0	5.2	4.8	1.1
1934	4.30	4.3	1.0	5.2	4.7	1.1
1935	4.40	4.4	1.0	5.4	4.6	1.0
1936	4.50	4.5	1.0	5.5	4.5	1.0

Table 1 shows that as prices increase expenses do also, due particularly to taxes. The net annual increase per annum therefore becomes less year by year unless the total annual increase becomes constantly greater. As the capital becomes larger, moreover, the interest rate which a given increase makes becomes less and less as the years go by. Speculation is therefore its own cure. In the case of those resources which need care as does the forest, speculation—anticipation of future values—hastens the day when care will be bestowed, but it also hastens the day when increase in value will not give a satisfactory return on the investment. That day is here or nearly here in the case of the forest.

What is the answer? From the investor's standpoint only one is, in my judgment, practicable. *Take as great a current return as possible without depleting the property*, and to this will be added as time goes on increase in value of the property as an additional return. This, with the forest means use for continuous production. The case becomes similar to that of the farm. Farm surveys by many agencies show conclusively that the average farm does not yield a current return of over 2 to 3 per cent, if the farmer is conceded wages such as farm laborers receive.[9] Much sympathy has been lavished on the farmer on account of these low returns, but all the time farmers in large numbers were retiring to residences in the town and purchasing pianos and automobiles. How could this be? The fact was that besides the current return from operation there was constantly accumulating a return from increase in land value, which increased in the middle west from the time when homesteaded 50 years or more ago to $200 to $300 per acre today. These increases in many cases, became noticable only when a sale was made. The increase in value, was in fact realized as time progressed without a sale of the property because the earnings of the farm continued to increase and pay the 3 per cent interest on a constantly increasing valuation. Now that land values are so high the increases in value are not likely to contribute much to the rate earned by the capital even should the arithmetic rate of increase continue to be what it had been in the past.

The case of the forest is precisely the same. Given a forest to start with which may be organized to give continuous yield and given stumpage prices at the beginning of even so much as 50 per cent per M and forestry will yield some net return. This is true, because the cost of regeneration cut-over land mostly by natural means and protecting

[9] See Roth's Forest Valuation, pp. 26–27, on this subject.

the small areas cut over does not amount to over 10 per cent per M feet cut for the first 10 years of the forestry operations. (See Table 2, column 23.) The remaining 40 per cent of the stumpage price will be more than sufficient for carrying the old timber when the valuation, and hence the taxes, are so low. Later on as the cut over and reforested lands increase in amount the expenses per M feet of the cut increase gradually until eventually when all the old timber has been cut at the end of some 60 years they amount to about $1.25 per each M feet cut, under our present tax system. Forestry will, then, eventually yield no net return unless stumpage is over $1.25 per M but we have already everywhere surpassed this point.

Too much emphasis cannot be placed at this point of the fact that as in the case of the farm, *this annual net return from forestry is only one of the returns from the property. The other return on which the lumberman has so far solely depended for his timberholding profit is the increase in value of the whole property.* But this increase in value of the whole property takes place just as readily when forestry is practiced as it does when the timber is worked as a mine, perhaps more so. Indeed, as has been shown, forestry removes the depletion charge from the property. It has been shown by Roth that the per cent on the investment yielded at any time varies little with prices of forest products. This follows both from the general principle of capitalization of net money yields and also the special fact in forestry that the capital remaining in the forest is wood of the same nature as the product and valued at similar prices. The percentic relation between product and capital cannot then vary greatly, aside from the presence of a surplus or deficiency in the stock of standing timber on hand.

This condition is the same as the case of the farm: if the net income rises, the value of the land rises, leaving the interest rate yielded the same. The most profitable time for forest investment is, then, when in addition to the current yield the annual increase in value is fastest. This increase in value in any year expressed as a percentage on the value of the preceding year *is greatest while the values are still low* (see Table 1), unless the total increase becomes greater year by year, which is not to be expected. *When, then, is the most profitable time to begin the practice of forestry*, assuming that it is started with the forest while plenty of mature timber is still on hand, which as I have said is the only practicable time for the private forest owner at least? The most profitable time is while the stumpage is still cheap. *This time is past for the Lake States, Pennsylvania, and New England so far*

as the valuable species are concerned. It is passing in the South and is still with us in the Pacific Northwest. In the first named regions forestry will yield little more than the current return in future, though that entirely justifies its practice where there are forests to work in. In the latter regions it is becoming certain that the forest investment will yield a favorable return in no other way except possibly in the case of a few of the large properties which survive the small holdings, and do not scruple to fulfill the predictions made some years ago by the Department of Commerce[10] regarding timber monoply. Of course even these can make more by taking both the annual return and the returns from increase in value.

The idea of using our forest resources to produce continuous product has gained little acceptance in America—none at all among the holders of the bulk of our remaining standing timber. The forest is, however, only nature's factory for the production of wood crops. Since nature has been on the job in American forests long before the advent of the white man with his civilization she has accumulated a large product in the forest factory. Heretofore, we have depended solely on increases in the value of this accumulated product for profits from the factory which we have proceeded to wreck as soon as the product was taken. But this is not the method we use with man-made factories. In these we expect for the most part to make profits only by continued operation and sale of the product. Taking the wrecking value of the factory gives but a poor return of the capital put into it. Careful consideration of the forest factory shows that the policy of taking the wrecking value is there, also, poor business policy. It terminates the investment at a large loss compared with the returns that can be secured by continuous operation. Wrecking the forest, that is, destroying the tree growth completely at the time of cutting means an immediate loss of nearly $10 per acre wherever proper methods of cutting would have secured natural regeneration practically free of charge. This loss is incurred because replacement of the stand entirely by artificial means will cost $10 per acre. Yet even after incurring this unnecessary expense the forest investment will show a profit in regions of rapid growth if operated under economic ownership. This proves conclusively that the wrecking of the forest caused a wantom loss of the amount named.

We must learn everywhere the lesson that, like other factories, the forest factory will yield most when continued in operation. The public

[10] See Part I, Report on Standing Timber, 1913, by that Department.

in its purchases of forest land which events have proved cannot be economically operated privately, should specifically recognize that the owner who has kept his lands in producing condition is entitled to full compensation therefor. Yet it is a question whether this has ever been fully recognized either by the Federal government or the States in purchases of forest land. Is it not a fact that young growth has been considered so much "velvet" in these purchases and the owners not compensated therefor?

In taking over the Biltmore tract, did the previous owners receive any adequate compensation from the government for keeping the forest in producing condition? Yet the tract is immensely more valuable as an investment by reason of past practice of forestry. It will yield a far larger immediate income than it otherwise would have done.

It may be said that even now the price of stumpage is high enough so that if a forest investment fails in a region of rapid forest growth, we should look to faults of physical organization of the forest, of business organization, and of failure to operate this factory of nature as a continuous producer, for the reasons for failure rather than to lay it on the weather, taxation, etc. The forest is, indeed, a more efficient factory than the man-made kind, because properly operated it is not a depreciable asset. On the contrary, intelligent use of this factory continually improves its capacity. European forests, which today show a larger wood product per acre than at any time in their past history, constitute ample proof of the foregoing statement. Moreover, forestry sufficient to maintain fair production need not be expensive. The forest has maintained itself remarkably even with man as a constant enemy. With man as a friend even though somewhat inactive, it will do wonders.

If a forest policy had been adopted instead of a timber mine policy fifty years ago in Michigan, just as much timber as has been taken from her forests in that time could have been taken and just about as fast but today these forests would be yielding nearly as great a cut of white pine as in the past. Their capital value would have been greater than at the beginning and far greater than the present value of some of the western forests, in which the wrecking value of those Michigan forests has been put. Instead of these values we have large areas of the State lying desert. Shall we make the same mistake in the South and the Pacific Northwest? *Can a State or Nation become great by transforming its lands into deserts?*

There is a persistent fallacy that forestry cannot be profitably

practiced unless stumpage prices are high enough to raise timber to maturity on a bare tract at a profit above all costs including compound interest. It is folly, if not absolutely wrong, to expect stumpage to bring cost of production unless this cost is taken for what it really is—the cost of taking over the virgin forest. It is better to have timber cut and put into houses at low cost than to rot in the woods waiting for higher prices. The cut timber will actually last longer in the house in many cases and while it is decaying there another tree will grow to maturity in the woods and be ready to take its place in a future house.

To justify this procedure our finance must be that of the continuous producing forest beginning with the vast stands we now have. The finance of the bare tract forestry is of little immediate interest or practical importance except for the purpose of weighing different methods of silviculture.

There seems, at first glance, an alternative policy to forestry open to the lumberman, namely: cut the mature timber at once and cash it in. This, however, government investigations show to be absolutely impossible. Why? Because these private holdings are of such size that they cannot be completely cashed in inside of 50 or 60 years, so far as we can see now. Since this rate of cutting is little, if any, greater than the forest will sustain forever, if properly handled, the only sound national policy for the mass of private owners is forest management. Without it, we see 2,200 billions of timber seeking immediately a market which will use only 40 billions annually. With forest management we see *limitation of the yield of each forest to what it will produce continuously.* This means that if forest management, according to tried principles which have been successful both in private and government work in those countries that make the forest a continuous producer of wealth, is practiced, *not far from our present cut will be seeking a market each year.* It is obvious that there is a vast competitive difference between the timber mine policy and forest production in this respect.

Private forestry has in few countries been so successful as government. However, in most cases the government is competing with units which are either too small to work in the most economic way or with a class of owners not given to foresight in business affairs. I am not convinced that working in larger units the large-sized American corporation cannot do as well as the government.

In European forestry the great government successes have been secured under forms of government where stability of policy is more

TABLE 2

1 Line.	2 Year.	3 Stumpage price of timber ready to cut*. Assuming average annual increase in value of past 25 years. 10¢ per annum	4 Area of land: With mature timber remaining uncut at beginning of each year	5 Area of land: Cut over by the beginning of each year	6 Area of land: Of young timber at the beginning of each year. To be reforested	7 Value of land: Bearing mature timber at beginning of each year	8 Value of land: Cut over by beginning of each year	9 Volume of timber: Mature timber on hand at beginning of each year	10 Volume of timber: Young timber on hand at beginning of each year	11 Value of timber: Mature timber on hand at beginning of each year	12 Value of timber: Young timber on hand at beginning of each year	13 Total investment in the forest: Account of mature timber. Mature timber plus soil it occupies. Timber mine policy	14 Total investment in the forest: Account of old and young timber and land cut over. Under forest policy	15 Cost of protection and administration year by year: Account mature timber	16 Cost of protection and administration year by year: Account young timber (The new stand under forestry)	17 Taxes year by year. Estimated 1% of actual value in each case: On land bearing mature timber	18 Taxes: On cut over land. Land valued at $2.00 per acre	19 Taxes: On mature timber	20 Taxes: On young timber following the removal of present stands	21 Cost of regeneration each year (1/40 acre at $2.00 per acre)	22 Total costs per M ft B.M. either forestry or timber mine policy not including any interest charges: Of caring for mature timber	23 Total costs: Costs per M based by forestry	24 Total costs: Care of entire forest organized for continuous production	25 Current annual net return per M ft B.M from either policy. Timber mine policy: From sale of land	26 From sale of timber	27 Total from columns 25+26	28 Annual return under forestry	29 Annual increase or decrease in value of whole investment (Appreciation or depreciation): Under timber mine policy	30 Under forest production policy	31 Current percent made on investment by net return from sales of stumpage: Under timber mine policy. Values from 13+27	32 Under forest policy. Values from 28+14	33 Percent made by investment by increase or decrease in the value of the property: Under timber mine policy. Percent made by returns in column 29 on values in column 13	34 Under forest policy. Percent made by returns in column 30 on values in column 14	35 Total percent made by current net return added to increase or decrease in value: Under timber mine policy	36 Under forest production policy
		In dollars	In fortieths of an acre			In dollars		In M ft B.M.		In dollars		In dollars		In dollars		In dollars				In dollars	In dollars			In dollars			In dollars	In dollars		In percent		In percent		In percent	
1	1917	$250	60	0		$750	$00	60		$7500		$8250	$8250	$300	$000	$0750	$0000	$7500		$.00	$11250	$0000	$1.13	$125	$137	$150	$137	$267	$280	18%	17%	32%	34%	50%	51%
2	1918	260	59	1		737	13	59		7780		8517	8530	295	005	0737	0013	7780		.05	11467	0563	1.20	125	145	157	140	276	290	18	16	33	34	31	50
3	1919	270	58	2		725	25	58		8070		8795	8820	290	010	0725	0025	8070		.05	11695	0625	1.23	125	153	166	147	228	240	18	17	26	27	44	44
4	1920	280	57	3		713	37	57		8310		9023	9060	285	015	0713	0037	8310		.05	11873	0687	1.26	125	161	173	154	297	310	19	17	33	34	32	51
5	1921	290	56	4		700	50	56		8620		9320	9370	280	020	0700	0050	8620		.05	12120	0750	129	125	169	182	161	237	310	19	17	32	33	31	50
6	1922	300	55	5		687	63	55		8930		9617	9680	275	025	0687	0063	8930		.05	12367	0813	132	125	176	188	168	258	270	19	17	27	28	46	45
7	1923	310	54	6		675	75	54		9200		9875	9950	270	030	0675	0075	9200		.05	12575	0875	135	125	184	197	175	238	350	20	18	29	35	44	53
8	1924	320	53	7		663	87	53		9450		10113	10200	265	035	0663	0087	9450		.05	12763	0937	137	125	192	204	183	237	250	20	18	23	24	43	42
9	1925	330	52	8		650	100	52		9700		10350	10450	260	040	0650	0100	9700		.05	12950	1000	140	125	200	213	190	237	200	20	18	23	19	43	37
10	1926	340	51	9		637	113	51		9950		10587	10650	255	045	0637	0113	9950		.05	13137	1063	142	125	209	221	198	218	280	21	19	21	26	42	45
11	1927	350	50	10		625	125	50		10180		10805	10930	250	050	0625	0125	10180		.05	13305	1125	144	125	217	230	206	206	220	21	19	19	20	40	39
12	1928	360	49	11		613	137	49		10400		11013	11150	245	055	0613	0137	10400		.05	13463	1187	147	125	225	237	213	217	230	21	19	20	21	41	40
13	1929	370	48	12		600	150	48		10630		11230	11380	240	060	0600	0150	10630		.05	13630	1250	149	125	234	247	221	187	200	22	19	17	18	39	37
14	1930	380	47	13		587	163	47		10830		11417	11580	235	065	0587	0163	10830		.05	13767	1313	151	125	242	254	229	138	210	22	20	12	18	34	38
15	1931	390	46	14		575	175	46		11040		11615	11790	230	070	0575	0175	11040		.05	13915	1375	153	125	251	264	237	148	160	23	20	13	20	36	40
16	1932	400	45	15		563	187	45		11200		11763	11950	225	075	0563	0187	11200		.05	14013	1437	155	125	260	272	245	167	200	23	20	16	17	39	37
17	1933	410	44	16		550	200	44		11400		11950	12150	220	080	0550	0200	11400		.05	14150	1500	157	125	268	281	253	157	220	24	21	13	18	37	39
18	1934	420	43	17		537	213	43		11570		12107	12370	215	085	0537	0213	11570		.05	14257	1563	158	125	277	289	262	128	190	24	21	10	15	34	36
19	1935	430	42	18		525	225	42		11710		12235	12460	210	090	0525	0225	11710		.05	14335	1625	160	125	287	300	270	128	190	25	22	10	11	35	33
20	1936	440	41	19		513	237	41		11850		12363	12600	205	095	0513	0237	11850		.05	14413	1687	161	125	296	308	279	127	190	25	22	10	11	35	33
21	1937	450	40	20		500	250	40		11990		12490	12740	200	100	0500	0250	11990		.05	14490	1750	162	125	300	313	288	87	100	25	23	7	8	32	31
22	1938	460	39	21		487	263	39		12090		12577	12840	195	105	0487	0263	12090		.05	14527	1813	163	125	315	327	297	78	90	26	23	6	7	32	30
23	1939	470	38	22		475	275	38		12180		12655	12930	190	110	0475	0275	12180		.05	14555	1875	164	125	324	337	306	68	80	27	24	5	6	32	30
24	1940	480	37	23		463	287	37		12260		12723	13010	185	115	0463	0287	12260		.05	14573	1937	165	125	334	346	315	47	60	27	24	4	5	31	29
25	1941	490	36	24		450	300	36		12320		12770	13070	180	120	0450	0300	12320		.05	14570	2000	166	125	344	357	324	37	50	28	25	3	4	31	29
26	1942	500	35	25		437	313	35		12370		12807	13120	175	125	0437	0313	12370		.05	14557	2063	166	125	354	366	334	38	50	29	25	3	4	32	29
27	1943	510	34	26		425	325	34		12420		12845	13170	170	130	0425	0325	12420		.05	14545	2125	167	125	364	377	343	18	30	29	26	1	2	30	28
28	1944	520	33	27		413	337	33		12450		12863	13200	165	135	0413	0337	12450		.05	14513	2187	167	125	375	387	353	13	00	30	27	1	0	29	27
29	1945	530	32	28		400	350	32		12450		12850	13200	160	140	0400	0350	12450		.05	14450	2250	167	125	385	398	363	-23	-10	31	27	-2	-1	29	26
30	1946	540	31	29		387	363	31		12440		12827	13190	155	145	0387	0363	12440		.05	14377	2313	167	125	396	409	373	-72	-60	32	28	-6	-4	26	24
31	1947	550	30	30		375	375	30		12380		12755	13130	150	150	0375	0375	12380		.05	14255	2375	166	125	407	420	384	-82	-69	33	29	-6	-5	28	24
32	1948	560	29	31	1	363	387	29	1	12310	01	12673	13061	145	155	0363	0387	12310	0001	.05	14123	2438	166	125	419	431	394	-93	-66	34	30	-6	-5	29	25
33	1949	570	28	32	2	350	400	28	3	12240	05	12590	12995	140	160	0350	0400	12240	0005	.05	13990	2505	165	125	430	443	405	-123	-104	35	31	-10	-8	25	23
34	1950	580	27	33	3	337	413	27	5	12130	11	12467	12891	135	165	0337	0413	12130	0011	.05	13817	2574	164	125	442	454	416	-182	-115	36	32	-11	-9	25	23
35	1951	590	26	34	4	325	425	26	7	12000	26	12325	12776	130	170	0325	0425	12000	0026	.05	13655	2651	163	125	454	467	427	-152	-116	38	33	-12	-9	26	24
36	1952	600	25	35	5	313	437	25	10	11860	50	12173	12660	125	175	0313	0437	11860	0050	.05	13423	2737	162	125	466	478	438	-173	-132	39	34	-14	-10	25	24
37	1953	610	24	36	6	300	450	24	13	11700	78	12000	12528	120	180	0300	0450	11700	0078	.05	13200	2828	160	125	478	491	450	-213	-153	41	36	-18	-13	23	23
38	1954	620	23	37	7	287	463	23	17	11500	119	11787	12369	115	185	0287	0463	11500	0119	.05	12937	2932	159	125	491	503	461	-232	-171	43	37	-20	-14	23	23
39	1955	630	22	38	8	275	475	22	20	11260	168	11535	12198	110	190	0275	0475	11260	0168	.05	12655	3043	157	125	503	516	473	-242	-171	45	39	-21	-14	24	25
40	1956	640	21	39	9	263	487	21	24	11050	227	11313	12027	105	195	0263	0487	11050	0227	.05	12363	3164	155	125	516	529	485	-253	-162	47	40	-21	-13	26	27
41	1957	650	20	40	10	250	500	20	28	10820	295	11070	11865	100	200	0250	0500	10820	0295	.05	12070	3295	154	125	529	542	496	-293	-188	49	42	-26	-16	23	26
42	1958	660	19	41	11	237	513	19	32	10540	387	10777	11677	095	205	0237	0513	10540	0387	.05	11727	3450	152	125	543	555	508	-312	-187	52	44	-29	-16	23	28
43	1959	670	18	42	12	225	525	18	37	10240	500	10465	11490	090	210	0225	0525	10240	0500	.05	11365	3625	150	125	556	569	520	-332	-209	54	45	-32	-18	22	27
44	1960	680	17	43	13	213	537	17	43	9920	611	10133	11281	085	215	0213	0537	9920	0611	.05	10983	3798	148	125	570	582	532	-373	-200	57	47	-37	-18	20	29
45	1961	690	16	44	14	200	550	16	48	9560	771	9760	11081	080	220	0200	0550	9560	0771	.05	10560	4021	146	125	584	597	544	-363	-191	61	49	-37	-17	24	32
46	1962	700	15	45	15	187	563	15	55	9210	930	9397	10890	075	225	0187	0563	9210	0930	.05	10147	4243	144	125	598	610	556	-372	-170	65	51	-40	-16	25	35
47	1963	710	14	46	16	175	575	14	61	8850	1120	9025	10720	070	230	0175	0575	8850	1120	.05	9725	4495	142	125	613	626	568	-462	245	69	53	-51	-23	18	30
48	1964	720	13	47	17	163	587	13	68	8400	1325	8563	10475	065	235	0163	0587	8400	1325	.05	9213	4762	140	125	628	640	580	-503	210	75	55	-59	-20	16	35
49	1965	730	12	48	18	150	600	12	75	7910	1605	8060	10265	060	240	0150	0600	7910	1605	.05	8460	5105	138	125	643	656	592	-513	215	81	57	-68	-21	17	36
50	1966	740	11	49	19	137	613	11	83	7410	1890	7547	10050	055	245	0137	0613	7410	1890	.05	8097	5453	136	125	659	671	604	-522	-170	88	60	-69	-17	19	43
51	1967	750	10	50	20	125	625	10	92	6900	2230	7025	9880	050	250	0125	0625	6900	2230	.05	7525	5855	134	125	675	688	616	-552	-170	97	62	-78	-17	19	45
52	1968	760	9	51	21	113	637	9	100	6360	2600	6473	9710	045	255	0113	0637	6360	2600	.05	6923	6287	132	125	691	703	628	-613	-180	108	65	-95	-18	13	47
53	1969	770	8	52	22	100	650	8	108	5760	3020	5860	9530	040	260	0100	0650	5760	3020	.05	6260	6770	130	125	707	720	640	-613	-105	123	67	-102	-11	21	56
54	1970	780	7	53	23	87	663	7	117	5160	3515	5247	9425	035	265	0087	0663	5160	3515	.05	5597	7328	129	125	724	736	651	-732	-105	140	69	-130	-11	00	58
55	1971	790	6	54	24	75	675	6	136	4500	4070	4575	9320	030	270	0075	0675	4500	4070	.05	4875	7945	128	125	741	754	662	-652	70	167	71	-144	-7	23	64
56	1972	800	5	55	25	63	687	5	145	3800	4700	3863	9250	025	275	0063	0687	3800	4700	.05	4113	8637	127	125	759	766	673	-713	00	198	73	-184	0	14	73
57	1973	810	4	56	26	53	700	4	155	3100	5400	3150	9250	020	280	0050	0700	3100	5400	.05	3350	9400	128	126	776	790	682	-853	-220	250	74	-300	-24	-50	50
58	1974	820	3	57	27	37	713	3	165	2260	6020	2297	9030	015	285	0037	0713	2260	6020	.05	2447	10083	125	125	795	807	695	-852	-90	350	77	-372	-9	22	68
59	1975	830	2	58	28	25	725	2	175	1420	6780	1445	8950	010	290	0025	0725	1420	6780	.05	1545	10905	125	125	814	827	715	-592	+140	573	80	-410	+16	163	96
60	1976	840	1	59	29	13	737	1	186	840	7500	853	9090	005	295	0013	0737	0840	7500	.05	0903	11687	126	125	831	843	714	-853	-140	938	79	-1000	-15	-62	64
61	1977	850	0	60	30	00	750	0	196	000	8200	000	8950	000	300	0000	0750	0000	8200	.05	0000	12450	125	125	850	843	725	.00		000	81	00	00	00	81
																														Average		-49	+2	31	39
																														Excess percent earned by forestry					08

Column 6 (lines 1–31): Young timber under 30 years old has no present value and is not taxable under general property tax.

Column 10 (lines 1–31): Although as measured in cu. ft. there is considerable volume on hand during this period it has no present value and is not taxable.

Column 12 (lines 1–31): No present value up to 30 years. This table is intended to give a picture from year to year of conditions in a forest placed under continuous yield management.

Column 20 (lines 1–31): No taxes on young timber until 30 years old.

Light face figures represent cost of holding mature timber.
Heavy face figures represent cost under forestry.

easily established than in democracies. Stability of policy is the all-important thing in forestry. There is moreover much reason to believe the American corporation is more capable of such stability than our political units. The Federal government is the only one of our political units that have attained any degree of stable forest policy.

I believe that it can be substantiated that purely as a business proposition forestry for the purpose of supplying permanent plants with raw material is justified just as the U. S. Steel Corporation is justified in providing raw material for 50 to 100 years in advance. To be practicable, however, there must be available, above all, cheap money. This can be had by pooling the borrowing capacity of the bulk of the industry in the money markets of the world as discussed hereafter.

Forest management, dealing as it does at all times with large bodies of standing timber, will continue to yield at least those increases in value of the whole investment that are secured under the timber-mine policy. It will in addition do away with depletion as a cost and yield a current annual return. This question has been examined from the standpoint of a typical case in the Pacific Northwest. In Table 2 is shown the approximate cost and return from handling a typical Washington or Oregon forest on the basis of a sustained annual yield.

This table is from an unpublished manuscript by the writer and is designed to show for a typical western Washington or Oregon forest to be organized at once for sustained annual yield, the approximate cost of forestry operations per thousand feet cut annually. It is also designed to show the cost of caring for the old timber remaining year by year as it is cut off during the first rotation under management. The forest is assumed to be a privately owned one, worked under a 60-year rotation. As the average acre of timber is considered to be 40,000 feet in this region, it will take 1½ acres of mature timber to cut 1,000 feet each year for 60 years. This table may be considered to represent such an area of one and one-half acres under regulation by simple area division method, or it may be considered to represent 60 sample plots of 1/40 acre each, located on the 60 annual cutting areas of a large forest under simple area division method or regulation. The former assumption is perhaps the simplest to grasp. Since 1,000 feet of timber is cut annually and all costs for the whole tract charged to it the result of this method is to show all costs of taxes, protection and administration, regeneration, etc., per 1,000 feet annual cut. Since we are determining the current annual results year by year, com-

pound interest is not involved. In other words we are working on a forest rent basis, *i.e.*, what will the forest earn each year on the investment?

Particular emphasis should be laid on the fact that today we have large forests, and that any effective forestry work we do must be with these forests. Therefore, we can best work on the forest rent basis. Any forestry we do on bare tracts will be insignificant. The deforested tracts on the National Forests have not even been planted yet, and will not be for years to come. It is alike useless then for the nation to acquire more of them or to expect the individual to undertake this long time investment. Emphasis must also be laid on the fact that in these Pacific Northwest forests as a whole, *we are not cutting and can not cut even at the rate sustained annual yield would allow. Therefore all the costs of holding and caring for old timber must be borne anyway whether we practice forestry or not.* This being true, the costs incurred on account of forestry are insignificant for years to come. (See column 23.) By these small expenditures, however, *the capital is made to produce forever instead of for the period the present mature stand will last.* In other words, *the annual cut constitutes no longer a one to two per cent depletion charge* on the timber investment, but an *annual return* on this investment. Speaking nationally, we can for annual expenditures of 2 to 5 million dollars a year, save a depletion charge of over 100 millions.

It is needless to say that 1½ acres could not be worked on this basis practically, but as the costs given are averages for large areas the results per 1,000 feet b. m. are intended to be representative. Therefore, results for larger tracts, or the whole region, may be estimated roughly by multiplying any element of cost or total cost per 1,000 feet by the number of thousand feet annually cut on a given tract or for the region.

Since the better forest lands here will produce over 40,000 M feet volume in 60 years, it may be assumed that cutting at the rate of 1,000 feet b. m. per annum will go on at the same rate in the young stand after the old is completely removed. Although in practice, thinnings can be made to yield about 1 cord per acre per annum in addition to the final yield, and can support a tremendous pulp industry in this region, they have been ignored in the forestry returns. It may be said also that the simple area division method will not give the best obtainable financial results, but has been adopted for its simplicity.

The writer desires to express the opinion that if his profession will

forget for the present most of the finance which it has been using, which has centered attention of everyone on forestry beginning with a bare tract, which certainly for years to come, if not always, is impossible for private owners, and scarcely less so for the State, and deal with finance of the established forest, we shall begin to get something effective done. We shall have no complete forest businesses to which it applies except with limited areas planted by the State or government which are no more than sample plots compared with our whole forest interests. If we can do nothing more than that, our forests will disappear while these plantations are in their infancy. Space does not permit detailed discussion of this table. Hence reliance must be placed on the column headings for making it clear.

It is evident from this table that at our present tax system and rates, allowing about four times the cost for protection and administration that the National Forests incur and more for regeneration, forestry is still cheap enough and will make in the neighborhood of 1 per cent more than the timber mine policy can do. How does it do this? Chiefly by saving the depletion charge. It is very certain, however, that general limitation of the cutting which would follow proper forest management would have a most beneficial effect on market conditions, so that the adoption of forestry as a general program would without doubt be of much more importance to the industry than the saving of the $100,000,000 depletion charge. It should tend to save some of the $60,000,000 cost of competition. Still it must be confessed it will not yield the speculative interest rate now paid by the industry. Moreover, in order to adopt forestry as a program, concerted action will be necessary. Therefore, again I conclude that preliminary to any effective steps for upbuilding the industry, national organization is necessary.

How Shall the Industry Organize?

Fortunately, on arrival at the conclusion that national organization is a necessity, I find myself in a large company. I have only traveled by a somewhat different route than most others. As a matter of fact, so many have reached this conclusion that it is now no longer necessary to discuss at length general principles. There are certain principles in such organization that should be, however, observed. The method of organization should be carefully considered from the standpoint of its effect on the individual as well as on the nation. From the standpoint of its effect on the individual it is obvious that no method should be used that limits the development of his highest powers. Two sets

of powers may be considered here. First, those which relate to the ability of the individual to make his own way unaided—to stand on his own feet—or self-reliance. American life has been preeminent in the development of these valuable qualities, and we should carefully avoid any method of organization which destroys these powers. The one-big-company idea which has been forced on some industries by the Sherman anti-trust law, is destructive of the liberty of the individual to a certain extent and we should not, in my judgment, adopt in the lumber industry such a method of complete surrender of individual liberty. Neither are individual lumbermen ready for such a method of organization.

Important as are these individual qualities of self-reliance and initiative the ability of the individual to cooperate with his fellows is no less so, especially under the American system of voluntary cooperation. This, then, should be the principle on which organization should be based, voluntary cooperation of units which conduct most of their operations independently, but cooperate to attain those ends which the small unit cannot obtain unaided. The plan of organization then, should, in my judgment, be a federation of existing industrial units.

H. D. Langille, at the Forest Industry Conference at Portland, Oregon, October 25 last, submitted such a plan which goes as far as present legal limitations will permit.[11] The only criticism of this plan is the limitations necessary by reason of these legal requirements. Under the present attitude of the public as expressed in the statutes the result is that a certain heavy handicap is put on industry which is then told to work out its own destiny.

At its origin, this public attitude was probably justified, but its results have alike fallen on the just and the unjust. It would, without doubt, be a mistake to throw the whole system of prohibition of restraint of trade overboard. There are certain hateful combinations of middlemen which arise from time to time and it may be combinations of producers who have complete monopoly of limited natural resources.

It is not too much, however, to expect that the time has arrived when each industry should be dealt with by the government on its merits. If no harm can come to the public through complete liberty to cooperate within a given industry that industry should be given the right of cooperation. In other cases, some limitations may be necessary in these grants. What I desire to affirm is that, having established definite

[11] See Lumber World Review, November 10, 1916.

agencies[12] for studying these matters, the least that can be expected of the government is intelligent individual treatment of each industry.

The recent government investigations of the lumber industry show it to be hard pressed. The 1914 census figures show an actual decline in persons engaged in the industry and also in many other respects. Yet this industry privately controls a great share of one of the three great resources which can be perpetuated forever. I maintain, therefore, that the public interests in conservation of this resource no less than the interests of the industry demand that complete freedom of cooperation be granted. It must be conceded, however, that if this freedom be granted, the public has a right to see to it in the grant that its ends be served as well as those of the industry. I hold that these ends are not different, however, from the permanent interests of the industry.

Central Association of American Forest Industries

Proceeding on the foregoing lines, it is proposed that Congress shall, through legislation, grant to forest industries the right to organize, providing a very definite principle is complied with. *This principle is that the right of membership in this authorized central association* (which I have called the Central Association of American Forest Industries) *shall be granted only to those individuals, corporations, associations, etc., which can and will make their business conform to certain reasonable standards of business management, labor management, and forest management, and treatment of the public, which it is agreed we can accept for American standards today.* The standards I have in mind should not be of any impossible nature. They should be determined so far as may be by scientific methods and for the rest by the careful judgment of fair-minded men. Table 3 is suggestive of the standards that might be required. It is obvious that such a plan would require a certain amount of supervision on the part of the government, but this could be far less than now extended to some other business; as, for example, the National banks. There would be nothing compulsory about membership in the association and the function of the supervision would be merely to give permission to cooperate in this voluntary way.

Since the industry could easily finance its own research if permitted to cooperate, in the long run the number of government men engaged on the problems of the industry would be small—nothing at all compared to the great host now engaged in the uplift of agriculture. The public

[12] The Federal Trade Commission and other government agencies.

TABLE 3.—*Membership Classes and Suggested Standards of Operation. To Be Determined by National Board of Standards for Forest Industry*

Classes of members	Forest management	Mill management	Retail yard management	Labor management
Class I, minimum required for eligibility to Central Ass'n.	Natural regeneration wherever possible at no cost. Complete fire protection of cut-over areas as well as in timber on non-agricultural land.	Minimum standards of financial and cost accounts for all mills.	The same price for each grade to each consumer in any given class.	Not over 10-hour day. Adequate housing.
Class II..........	Complete fire protection. Natural regeneration wherever possible at reasonable cost with a view to continuous production.	Above plus proper balance between owned and borrowed capital.	Above plus efficient merchandising.	Above plus wholesome amusement plus continuous employment and education in proper use of leisure time.
Class III..........	Above supplemented by artificial regeneration when necessary to establish full stand if artificial regeneration is determined to be economic under the circumstances.	All above plus good standing with credit men and with banks.	All above plus service to the consumer, showing how to use wood in general way.	All above plus nine-hour day plus minimum wage sufficient to maintain a family in suitable surroundings. Opportunities to invest in bonds of the company.

Classes of members	Forest management	Mill management	Retail yard management	Labor management
Class IV.........	All above plus suitable organization of the forest to provide for cut for natural life of existing mill plants.	All above plus the beginning of efficiency management designed to make best use of capital and equipment.	All above plus detailed service designed to give consumer complete education as to when and where to use wood and what species and grades to use.	All above plus opportunity to participate in stock ownership and take part in management of company to the extent of stock holdings. (It should not be inferred that employees should own controlling interest.)
Class V..........	All of I plus III plus organization of forest for sustained annual yield including the constant maintenance of sufficient growing stock, etc.	I plus III plus complete efficiency management —management that manages—making every factor count to the utmost in economical production.	All above plus carrying this branch of distribution at lowest practicable expense.	All above plus the attainment of actual high standard results in creation of stable, virile American citizenship.
Class VI.........	Coordination of forest management with agricultural and other industries of the region with a view to highest prosperity for all.	Further improvements in production.	Further improvements in yard operation and steps taken to cut out all unnecessary duplication.	Progressive improvement in means available to create continually higher standards. Open opportunities for utmost development of each grade of ability and the discovery of genius.

would thus be relieved of a great tax burden, which is sure to grow unless the industry is allowed to provide for itself.

The supervision of admission to the association could, perhaps, best be carried out by a commission representing the Federal Trade Commission, the Departments of Commerce, Department of Labor, and Department of Agriculture (the Forest Service) respectively. Its function would be to establish the standards of admission and then examine applicants for admission.

Since the association would be a federation of timber owners, corporate or otherwise, manufacturers, retailers and large consumers of forest products, it seems obvious that the government of it should be vested in a council of 15 to 20 members, large enough to give representation to each part of the industry and the country. These members could be elected regionally or at large, by giving the owners of standing timber votes according to their holdings, manufacturers according to their annual cut, retailers according to their sales, and large consumers according to their purchases. Congress should require the Forest Service and other government branches controlling forests or timber to become members. If so, they should have the same voting power as other members which would, no doubt, give the government one or two members representing these departments on the council. For the sake of the industry, the Federal Banking Board should have a representative on this council for reasons I shall later explain.

The field of endeavor of such an association is more or less obvious. It would include, in the first place, all those items mentioned by H. D. Langille.[13] Langille has gone further into that field than time permits me to do and little could be added to his text regarding activities now considered as being the legitimate field of association activities. An association buttressed by public approval expressed through Congress could carry out all of these things more effectively than any association formed under present conditions can do, because of the twilight zone which now shrouds in doubt the legality of many possible association activities.

A few departments covering ground not covered by Langille need some discussion.

The Finance Department

The function of this department would be to organize the credit of association members; to put the credit of the forest industry on a

[13] Lumber World Review, November 10, 1916, p. 49.

conservative investment basis, as has already been discussed. It has been shown that possible savings in interest charges in the industry may ultimately amount to in the neighborhood of $60,000,000 or more annually. No new or startling financial methods are necessary to begin making large savings in this direction. The central association should market large bond issues based on the bonds of its members as collateral.

The method of operation of the finance department should be somewhat as follows: it should, after careful investigation of each individual bond issue, receive the bond issues of the member corporations of the central association. On these bond issues as collateral should be based central bond issues of the whole association which would be issued in series of such size as to attract attention in the bond markets of the world. It is in connection with the acceptance of these collateral issues that the representative of the Federal Reserve Board on the governing council of the association would be of tremendous advantage. This representative should serve on the finance committee empowered to make final acceptance of individual bond issues as collateral for the central association issue. He might well be empowered by law to refuse as collateral any individual issue not complying with the terms of the act authorizing the formation of the association.

This act should contain a section dealing with the method of handling these bond issues. This section naturally would limit the collateral issues to perhaps 40 to 60 per cent of the appraised value of the tangible property of the corporation concerned. There should also be limitation of collateral issues as to the net income available to pay interest charges. There should, further, be definite provision requiring a definite percentage, say 5 per cent, of the interest returns from collateral bond issues to be set aside as a reserve fund, which shall be for the purpose of making good to the central association bond issue any losses from default of collateral issues. The deposit of this reserve in the Federal Reserve banks at a low interest charge might well be required by the law authorizing this association. This reserve fund should be limited perhaps to 5 per cent of the total central issue and kept at that figure. Such other wholesome restrictions as seem necessary may be imposed. The Federal Reserve banks might well be made trustees for the central issue and have custody of the collateral issues.

These suggestions do not contemplate any guarantee of these securities by the government. Thus the credit of the government would be unimpaired. On the contrary its credit is enlarged by the conservation

of the nations capital which is the source of government borrowing when this becomes necessary.

The effect of these or similar provisions which have been only briefly indicated seems to me obvious, namely, that these securities issued under the supervision of the U. S. Government can legitimately seek a conservative investment field which means at the start perhaps 4½ to 5 per cent money, and ultimately perhaps 4 per cent money. Of course, the expense to the central association and provision for reserve funds means that the ultimate borrower must pay from ¼ to 1 per cent more than the central issue.

Although only government supervision is contemplated here, it would be legitimate to make these carefully guarded securities legal investment for savings banks, insurance companies, trust funds, etc. As funds of these institutions are constantly increasing, there is no doubt of there being an abundance of capital seeking such an investment as this, if it is put on a strictly gilt-edge basis, and why can it not be. Is there any danger of these more than $7,000,000,000 of assets of forest industry shrinking even 25 per cent? No one will I think, affirm this. Then, bonds based on 50 per cent of the present values must be safe as to principal if each collateral bond issue is based on careful appraisal and forms a conservative percentage of the appraised value. On considering the question from the standpoint of the collateral bond issues; it is obvious that while possibly some concerns, owing to too heavy indebtedness, already, could not now get out a safe bond issue; it must be that large numbers of concerns have assets and income which warrant good sized issues with no doubt as to their safety. These are entitled to cheaper money, but their relatively small issues now attract no attention in the money market, and, moreover, suffer by the general reputation of timber bonds. The plan of handling them by this central association contemplates that should any collateral issue default and have to be liquidated, the liquidation will be done "within the family" without loss to the investor in the central bond issue. These liquidations should be handled by the next department.

These suggestions do not contemplate the furnishing of short term loans through the central association. These should, as heretofore, come from the banks. In so far, however, as the income of individual companies is conserved through paying lower interest rates on long term loans, then short term credit should be bettered. This is, of course, of mutual interest to the industry and the banks, because at the same time the credit of the industry is bettered, the safe loan field of the banks is

enlarged. Adoption of standard accounting methods and financial statements will also contribute to this end. Elimination of risk will tend to make bank loans more available and at the same time warrant lower interest rates. The lower interest rates are not necessarily a loss to the banker, however, because the average earnings of loan business may, at the same time, be increased through elimination of losses.

It is not to be supposed that even if central association bonds could be placed at 5 per cent or under, there should at once be radical reduction of interest charges to members. Since "money talks" as nothing else does, the interest charge to members in Class I (see Table 3) should be, say 5 per cent, and that perhaps ¼ per cent should be taken off the interest charge for each advancement from class to class of membership. This would be a powerful incentive to each concern to advance its standards of management in all phases as rapidly as possible. It would, moreover, be consistent with good financial policy, because, the higher the standards of business management, the less the loan risk and the lower the interest rate justified. These reductions in interest charges could be accomplished at any time if each bond issue provided that it might be retired with consent of the central association, by issuance of refunding bonds; or each issue might provide a definite interest rate to be paid according to the membership class of the individual concern at the time interest is due. These interest rates would thus be made to constitute a premium for efficiency, something that must be carefully looked to when we concede certain earnings to industry.

Considering this question from money lender's standpoint it has already been shown that savings in interest rates are not in nature of savings to the industry and loss to money lenders. They are real savings due to elimination of losses of capital by suitable organization of industry. Since the loss of capital in considerable part falls on the money lender under present conditions he has to charge high interest rates to cover his risk and insure an average return of even as much as 4 per cent. Of course, in practice the losses fall on the less astute and the high earnings go to the more astute. This plan contemplates organizing the borrowing powers of forest industry so that as much capital as can be got without risk to the lender can be secured at the low terms warranted by the elimination of risk. The remaining capital needed will have to be drawn from lenders willing to take risk for a consideration and will pay interest rates similar to the present. In

effect, by limiting the loss of property we may, by this means, make it possible to reduce property income to the owners of the capital engaged in the industry and thus make it possible to divide a larger share of the product between labor and the consumer.

There should be added a neglected field within the industry itself for securing both investment and speculative funds. I refer to the employees of the industry. These receive nearly $300,000,000 a year for their services, yet comparatively seldom it is that any of these invest in the securities of the concerns they work for. Wherever capital earned by employees in the industry goes back into it, it is often in the form of new enterprises started by men formerly working for salaries or wages. Would it not be better to have this capital enlisted in the support of existing enterprises than to go into competing enterprises often to be used up in putting products on the market below cost, a kind of competition most difficult to meet. The logic of the situation seems to justify the conclusion that it would be vastly to the interests of the industry to secure for itself both the investment and speculative funds available from savings of employees. The former might be secured by selling central association bonds over the counters of all members, giving bonds instead of cash for bonuses where bonus systems of wage payment are used, and in other ways. The speculative capital of employees, if enlisted at all, would naturally go into stock holding. The results of this partial distribution of the ownership of the industry among its own employees may be expected to be of far greater importance than the mere saving and investment of capital. It may be expected to have a vital effect on labor conditions.

Department of Financial Reorganization

All collateral bonds should be issued under trust deeds providing that the central association may take immediate possession of the property in case of default of interest or principal of the bonds, lasting a very short time. This is where, as we have said, this department should step in to liquidate these bond issues "within the family." If this be done the outside investor will no longer come in direct touch with any defaults, and as a consequence the merits of the central bond issue will constantly be enhanced in his opinion. In case of default of a collateral issue this department should step in at once, make a thorough examination of the business concerned and, if possible, set it on its feet again. If reestablishment is not possible a distribution of the assets among adjacent concerns at prices which will cover the bond

issue is indicated. Here, for example, would sometimes be an opportunity to transfer blocks of timber to federal or state ownership under which forms of ownership the interest cost of carrying them and working the forest on a continuous production basis would be only 3 to 4 per cent. Mills and logging camps might be transferred to other companies or the defaulting corporation, relieved of the burden of carrying the timber, might be able to operate them profitably, buying back as needed the timber transferred to state or nation. The field of this department is thus rather obvious. It might well be extended to give aid to any association member desiring it without waiting to perform a post mortem after the member is in default.

Department of Standards

Lumber associations have gone far in developing standard shapes and sizes of lumber but much remains to be done in placing these grades on a more scientific basis. Moreover, grading should be extended to every forest product to the end that the purchaser of said product who purchases by central association grades can order as well by phone or letter as by personal inspection. It is especially necessary for foreign trade that grading be rigid. Present methods in foreign trade as pursued in some sections of the country are absolutely fatal to its permanence.

Another set of standards which might well be developed is in the case of all kinds of machinery. The experience of industrial engineer in other lines shows that in many cases even new machines are not geared for most efficient speeds or otherwise capable of giving maximum output. Similar results in sawmill machinery have been recently secured in at least one Western Washington mill. The machinery has been found capable of far higher speeds than recommended by the manufacturers. The department of standards should, by exhaustive operating tests, develop the most efficient machine for each class of work; determine the best operating speed, etc. The purchasing department could then purchase for all members at factory cost sufficient of these to cover the entire needs of the membership.

Purchasing Department

This would be an optional activity, but it seems obvious that by concentrating the purchasing in many lines much could be saved. Savings would come through eliminating the traveling salesman where unnecessary. Wire rope and all kinds of machinery could be purchased at the factory, shipped in carload lots to distributing depots and then distributed to members on order. Since all of these goods would be

standard and sold at a standard price, the cost of purchasing would be cut down.

Another most effective field for this department might be in purchasing abroad those articles needed by the industry which could there be purchased more cheaply. This foreign purchasing could be made a definite lever for expanding exports of lumber, *by doing lumber industry purchasing in certain lines in those foreign countries and cities which will purchase American lumber.* There are still many who think that we can produce all we use at home and send a surplus abroad, that is to say, take nothing but money for our exports, but recent discussion of "economic alliances," etc., is gradually forcing on the popular intelligence the idea that foreign trade means trade of goods for goods or goods for credits. Therefore, there is no reason why the lumber industry should not definitely use its purchasing power abroad and at home to sell more lumber. It means strictly that we trade something we can produce more cheaply than the foreigner for something the foreigner can produce more cheaply than we. This is the only proper kind of foreign trade—that whichis mutually beneficial. It should be decidedly effective in promoting trade if the trade representatives of the lumber industry abroad be able to go to the commercial organization of a foreign city and say, "If you can arrange to buy the lumber your city imports from us, we shall be able to purchase certain of the products you manufacture for exportation to the United States." The exchanges resulting could, of course, be easily arranged through the banks. This method only brings us back to the original trade method of barter which is really the basis of trade today though lost sight of in the complicated exchanges now effected through the use of coin and credit money. It is still a most effective method when the person you wish to sell to, and who wants what you have to sell, has something you wish to buy.

Selling and Price Regulation

This subject must be treated because it is one bound to be raised. This is not an absolutely essential activity of the central association but is one which it should be free to enter if desired. It is extremely unlikely that any plan of price fixing would be successful in an organization of this kind where members are free to withdraw. Members who are unable to operate and sell enough lumber above the total cost of production or above any certain fixed price, to pay such fixed charges as interest and taxes, are going to sell for less, if possible to

make any net return whatever above direct current operating costs. Therefore, neither price fixing nor cost accounting will be effective in preventing all sales below cost of production.

On the other hand, price fixing in this industry has no menace toward the consumer. The condition of the industry in regard to overload of standing timber and over investment in plants, etc., make it absolutely imperative to move as much timber as possible on to the market each year; the competition of substitutes likewise precludes general rise in lumber price. The success of the organization will necessarily be based solely on savings which it is now known positively are possible in many directions, together with education of the consumer which will increase the use of wood. Only one condition might arise that would be unjust to the consumer, namely, that in certain localities, where substitutes are not active, prices might be shoved up while in others they were reasonable. As a safeguard against such action, the act authorizing this association should specifically prohibit discrimination in prices between localities and between different purchasers of the same class either by the Central Association or its members. This simple safeguard is ample, though additional provisions of the sort possess little threat from the standpoint of the industry. As radical advance in prices is impossible anyway, although if such advance were necessary the consumer could stand a slight increase, if we may take the vast sums spent for wines and liquors, tobaccoes, movies, etc., as any evidence of the resources of the average consumer.

As has been pointed out already, there is only one safe and sure safeguard to prices, which at the same time squares absolutely with the public's immediate and long-time needs. This, as has been indicated before, consists in placing all the forests of the country on the basis of continuous yield. If this be done, the first step, after providing for regeneration of cut over areas by natural and inexpensive means and the protection of all the forests against fire, would be *limitation of the cut of each producing unit to what it will produce permanently.* This, at one stroke, means that the amount of timber seeking immediate market would be reduced from 2,200 billions of feet (the amount now in private ownership) to little if any over what the market is now taking annually. The psychological effect on the market must be evident. The selling problem would be tremendously simplified since it then becomes only a matter of increasing either the domestic or foreign market to the extent of a few billions of feet annually. As compared to this problem, the selling problem involved in getting 2,200 billions, worked under the timber

mine policy, on the market quick enough to satisfy the timber mine owners is insoluble.

In order to absorb this tremendous quantity, the consumer should not only have to live in wooden houses, but wear wooden shoes, wooden clothing and eat wooden breakfast food. This would last only a few years, however, until the destruction of the forest resource could be profitably (from the standpoint of the timber mine owner) completed. After that the consumer would have to use concrete and steel substitutes for all of the above.

The only effective maintenance of price must be one through limitation of the quantity placed on the market. The only sound limitation of the amount to be marketed annually is that imposed by what this resource will produce continuously. Bad as that forestry is which overcuts any given producing unit, that which undercuts is still worse because it neither furnishes revenue to the owner nor supplies the consumer with product. The only safe forestry is that which take the full yield right along—thus giving the owner the maximum financial return at the same time the public gets the maximum product. American forest resources should be made permanent and continuous revenue producers. Such a policy would create for American forest industry a simplified selling problem of disposing of not more than 40 to 50 billion feet annually with present standards of utilization. The remainder of the manufacturing and selling problem consists in making into usable products and finding a market for that vast quantity of by-product now wasted. So long as we have the timber mine policy with its 2,200 billion feet of high-grade timber seeking immediate market, we can be sure that small progress will be made in marketing the material now wasted. If the process of liquidation of timber holdings, predicted by many, takes place, we shall lose much ground already gained in this field because unlimited quantities of high-grade timber seeking a market leave no room for utilizing low-grade by-products.

Obvious as is the necessity of handling the privately owned forest under continuous yield, which will at once remove the depletion charge from the forest capital and limit the market supply to an amount that can be absorbed at a profit, it must be admitted that there is no hope of such solution of our forest problem without effective organization. Without organization, the concern that enters on a continuous yield policy will continue to be subject to destructive competition from concerns working under a mine policy, which are merely taking the wrecking value of the forest. Experience has demonstrated time and

again that good markets for lumber are ruined almost immediately by over-supply originating under this policy.

Given effective organization, the lumbermen can solve their own problems, but they cannot do so with hands tied behind them as has been done and is the case today. Without the right to organize effectively it will be necessary to continually increase government aid, and do, at the general expense of the community, what the industry is not permitted to do for itself. A horde of government investigators will be necessary to investigate markets, utilization of by-products, etc., and supervise the industry. This will gradually weaken and eventually destroy that self-reliance which has so far, in the main, characterized American industry. In place of it will come dependence on a paternal government for the privilege of industrial existence.

It is not, of course, advocated that organization for continuous yield should be carried out in a high handed or unintelligent manner, which would deprive existing mills of their raw material. The situation can be remedied only gradually. If the cut of forests is limited by producing units to what these units can produce continuously, the result will be to put a stop *in future* to the building of unnecessary mills. Wherever only one mill can be supported permanently, only one will be built. This means that depreciation, interest and maintenance are confined to one plant and depreciation of plant due to exhaustion of raw material eliminated.

Objections to Organization

First in the minds of many is the fact that effective organization requires exemption from the action of the Sherman anti-trust law. This act has come to rank in sacredness along with the Constitution to such an extent that the politician dares speak of its modification only in whispers. Nevertheless, there are now many so bold as to suggest that the originators of this act were not gifted with divine fire and that, anyway, times have changed since its enactment. Is it too much to ask at this late date that each industry be dealt with according to its needs and merits? We are now to have special legislation permitting combinations for foreign trade. That is to say, it is recognized that in foreign fields the consumer must be served with standard goods from the price of which the cost of competition has been eliminated. The American consumer will not have the privilege of this service, however, because competition and the industrial gambling which accompanies it is our fetish.

Again this will be said to be special legislation. Well and good, that is to say that this industry is to be dealt with according to its needs and merits. It embodies a very special case in industry, dealing as it does with a raw material which though reproduced with ease takes a half century or more in the production. Special foresight is thus required and special methods of physical organization of producing units in order to secure annual yield from each under these conditions. We have, moreover, ample precedent for legislation according to needs of particular industries. The railroads have been dealt with by an enormous body of special legislation. Yet the public service differs only in degree between that industry which supplies the material to erect a roof over our heads and that which transports the material. But we do not have to go to transportation industries for examples. Agriculture is subject to a mass of special legislation. Here, however, the government has chosen to do for the industry instead of letting it solve its own problems. Here too, we see the paternalistic attitude most highly developed. While the American farmer is still self reliant it is evident more and more that the government is being looked to solve the difficult problems. How long the quality of self reliance can last under these conditions is a question.

There is also being built up a body of water-power legislation, while other industries are coming in for their special treatment. This is as it should be. It would undoubtedly be more unwise to repeal the Sherman anti-trust law than it is to make it a blanket to cover everything. *In those industries where organization is inevitable and the only solution of the problem, the Sherman law should be removed as a bar to those looser and more democratic forms of organization which will leave the individual concern free to develop its own type of efficiency and yet will secure the results necessary in certain fields such as have been discussed in forest industry. Without release from the prohibition of the Sherman law we shall eventually get organization on the one-big-company idea as we already have it in steel and oil.*

Both our ability to organize industry and the maintenance of our resources in producing condition have a broader industrial significance than in those regards so far touched upon. Recently much discussion has been heard regarding the United States taking a larger place in world trade. Much of this discussion is of so vague a nature that its real aims are impossible to state in specific terms. Apparently there is quite a general idea that we should follow industrially in the footsteps of England and Germany, which means to a great extent the impor-

tation of raw materials and their elaboration and export. It seems to me that there is ample evidence that this is too late a date in the world's history to enter on such a policy with success.

New England, our most exclusively manufacturing section on the English and German plan, would be in better shape to face the future if she had better conserved her forest resource as a source of raw material. Manufacturing competition is exceedingly keen and will be keener in future as manufacture goes nearer the sources of raw material. New England's factory towns are going to feel the pinch. New England may therefore see hard times ahead. Her labor by low wages and skill will have to make up the cost of transportation to and from her factories which are distant from many of the raw materials they use.

The world game of bringing raw materials from one country to another to be manufactured and then sent back is about played out, except for those populations which are as yet satisfied with low standards of living. Capital is cosmopolitan and will not object to going to the raw materials and producing the manufactured articles there. The United States, in expecting to develop this system of bringing in raw materials and sending out manufactured ones, instead of conserving her own resources as a source of raw material, is leaning on a broken reed.

The epic conquest of America by the pioneers was a wonderful achievement of which every American of today should be justly proud. This does not mean, however, that the methods of yesterday will suffice tomorrow to maintain the position America has won. Here, in fact, lies the supremest test of democracy. The future will unfold whether democratic institutions will suffice to conserve these material bases of our civilization or whether such conservation can be practiced only by centralized and unrepresentative governments. We may be sure that only one thing, general public education on these subjects will accomplish the desired results. In this education, economists and pseudo-economists of the old school of "*Laissez faire*," "What is, is right," "Let the future take care of itself," etc., are not going to be very useful factors. It seems entirely clear that democratic institutions cannot live unless we can develop the necessary foresight to keep our natural resources producing. If we do not do this we shall have the problem of constantly increasing population to support with constantly decreasing resources. This means in the long run a constantly decreasing standard of living which will carry with it lowering standards of education without which a democracy cannot endure. With population

pressing close on the means of subsistence, only the few living on the backs of the masses can have the leisure for development of the arts and sciences. The only way to maintain an adequate national standard of living with certainty is to base it on intelligent use and conservation of its natural resources. A few small nations have lived mainly by trade and manufacturing, but we could proceed on the basis of no more arrant folly than to believe a nation of the size of the United States can so live at this stage of world development. An intelligent national policy should develop its own resources to the maximum with a view to permanence, sell those things to foreign countries which we are best fitted to produce and receive in return the products which these countries can produce more economically than we.

As to forest industry, we have much of the best forest producing land in the North Temperate Zone. If we even maintain our present standards of housing and industrial structures, particularly farm structures, we shall need mostly not all of the permanent product for ourselves but if we have any surplus it is one of the things that foresight on our part will always make available to trade on advantageous terms for things we need from other countries.

It is axiomatic, therefore, that this resource must be maintained If private ownership cannot do it, then collective ownership must and will, because agitation in this problem will not cease until it is solved There is a field here for private ownership providing there is available cheap capital, intelligent distribution of forest products, and some let-up in destructive competition. I hold, with many others, that none of these things can be secured in adequate degree without permission on the part of the federal government to bring about some form of complete cooperation. I hold further that the interests of the industry are such vital public interests that the government is remiss in its duty if it does not actively aid the organization in the way that will be most expedient without necessitating permanently meddling in the industry on a large scale.

I have dwelt chiefly on organization as a business need, together with its necessity if the forest resource is to be perpetuated and made the most of. It is also a social need. In the wake of forest destruction in America has followed an enormous human waste. Transient and unstable industry is not an atmosphere where the family life can thrive. Consequently, the old New England lumberman has been nearly exterminated as a race. The former Lake States woodsman is now rare, his place having been taken first by the North European, who is grad-

ually being displaced by the laborer from southern Europe. Only existing American immigration policy prevents the filling of these positions by oriental labor. Whenever we desire to put our forest industry on a stable basis where each forest will yield continuously and each mill be a permanent institution, we can introduce the permanent town, the school, the church, family and community life. As this work is carried on in the great out-of-doors under wholesome conditions the introduction of stability into it should make it a contributor to racial upbuilding as agriculture has been in the past. Under these conditions, the American woodsman, instead of being notorious for his dissoluteness, should become proverbial for his steadiness and his dependability in time of national stress as the woodsman of Europe is known today.

Additional reasons for larger organization are plentiful. Large scale organization must, of necessity, pay special attention to the discovery and reward of genius. There are geniuses in the industry today who, because of the small organization with which they are connected, devote only a little of their time to work calling for full exercise of their powers and the rest of their time on work which could be delegated as well to those less gifted much to the advantage of both.

The development of leadership is equally important. The majority of the present leaders of the industry must feel within them our consciousness that if they could extend their influence over a wider field improvements in the industry could be forwarded more rapidly. This feeling is not mere egotism, but necessary self-valuation to those men who are capable of leading great enterprises. The possibility of extending wider influence to these men by wider organization does not, however, mean restricted opportunity to others, but quite the contrary. Every man who has worked in an organization provided with great leaders must have felt that his own powers were enormously multiplied by the association. A democratic method of selecting the members of the council which shall then have full authority to select heads of departments would provide for the development of such leaders.

Moreover, national organization of industry will be effective in keeping us from sinking into that provincialism with which we are in imminent danger, because, with the complete settlement of the West, our national migrations on a great scale have ceased. National organization of industry means thinking nationally in political matters. National organization of industry is then a national necessity if "American-

ism" is to represent some degree of national unity rather than an average struck between 57 varieties of provincialism.

Alternatives to Organization

It is, as has been already recognized, possible to have the government step in, make scientific and industrial researches and supervise the industry. The object of effort along any line being to increase the efficiency of the industry and better its service to the community the query may be raised as to whether this betterment of the industry can best be brought about by those who are in and have experience and training therein or by outsiders with no knowledge thereof or only theoretical at most. Paternal control and administration by the government means much of the latter. It further means that the investigators under these conditions are perpetually condemned to thought without action. Under this condition it is the exceptional man who is able to pursue his work energetically or keep it on a plane where it can be immediately usable. I do not question the enormous basic value of the work of pure scientists, but only a few can be content to pursue science for its own sake. Most of us are spurred to greater efforts by seeing our discoveries put to successful use. In agriculture it is known that the practice lags far behind the knowledge but the research is organized outside the industry. Would it not be advisable in forest industry to have the research *organized within* the industry as here proposed, so that the discoveries of research men can somewhere be put into immediate effect on a commercial scale oftentimes under the direction of the discoverer, or in other words under the conditions best making for success. I have already suggested that to let the industry work out its own salvation, but with free hands, is best calculated to perpetuate the traditional American qualities of self-reliance and self-respect. Moreover, since no practicable amount of research and market extension can market in a hurry 2,200 billion feet of timber in private hands, all this work will by itself fail in permanently solving the problems of the industry. Cost accounting, useful as it is, will not prevent any man from selling below cost of production, when he has interest and other fixed charges to meet, neither will it prevent the wastage of assets on the part of mills shut down because they will not sell lumber below cost of production. Remember that one-third of our mills must, on the average, be shut down, hence depreciation is going on in these without being reflected in product.

Eventually, therefore, if the government is to be universal solver

of our industrial problems it will have to attack that thing which the majority of us love most dearly—the competitive system in industry. It can issue (if constitutional authority be granted) certificates of public necessity to all mills and refuse to license the erection of those not needed. If the government is to be the solver of the problems there is, in my judgment, more likelihood of collective action under which it will own and operate the mills themselves and distribute the product not by distributing machinery which is in duplicate or triplicate, but in the manner in which the Post Office Department is operated, namely: one post office to each town or portion of country or city that needs one with the inevitable inefficiencies of small-scale production and the chaos of unorganized distribution. So much for government management of the industry as it is.

A more immediate alternative to be expected than the foregoing is banking control. We are now, in fact, rapidly entering on that stage. Government officials are practically advocating it through the advocacy of withholding loans from concerns with inadequate systems of cost accounts.[14] It, of course, follows that the accounting system will have to show that the business is making good in order to get loans. We need cherish no illusions in regard to this. Under this system the loans will go to the strong, while the weak will go to the wall. "To him that hath shall be given, while to him that hath not shall be taken away, even that which he hath." The strong will grow constantly stronger, while the weak will be broken on the wheel of adversity. If this were a law of nature which demands that the fittest shall survive we should, of course, be constrained to accept it philosophically. It is, however, not necessarily due to the incapacity of the individual who fails. It is only that our competitive system demands not only financial strength and ability but also in many cases ruthless and unfair methods. If the individual could work under fair conditions he would win, in many cases where he now fails. Failure is more due to the individual being refused the right of effective cooperation with his fellows, and working on in ignorance of true conditions.

Banking control will eventually result in large and centralized concerns operating in each region. If these concerns cannot get together to cease destructive competition, the bankers will see that they do. *Furthermore, capital will not be advanced to build a plant where the region*

---

[14] See statements of Trade Commissioner Edward N. Hurley, reported in Lumber World Review of Chicago, October 24, 1916.

is already served because bankers have learned that it does not pay to put in capital where it will be destroyed together with its competitors. That knowledge has been put into effect in the railroad world and the water-power world. It will be put into effect in other industry. I am frank to say that if we as a people have not intelligence enough to do these things for ourselves we are fortunate to have bankers intelligent enough to do them for us. Yet we must recognize that banking control is, to the public, one of the hateful forms. It is dangerous for the banking world to take on this function because it is conceivable that it might lead to a reaction which would sweep away private banking altogether or deprive it of all liberty of action. It will be better for the banking world if we let forest industry exercise self-control through cooperation. This will make a safe loan field of the industry which is all that the banker can legitimately demand. Then again if we force on the banker the necessity of controlling all industry his burden will be too heavy and the results he will get will not be equal to those to be had by letting the men of each industry who know its conditions best, control it themselves.

Conclusion

To sum up it may be said that existing conditions are intolerable, especially as to destructive competition, that control of the industry we must have in order to better conditions or this resource will be seriously impaired. Regardless of the public interests, we may be sure that control will come. Unlike some of our other industries, the choice is still open between effective democratic organization first or an autocratic organization controlled by banking interests and eventually by highly centralized concerns. The democratic organization will permit existing moderate sized units to combine for those things where national cooperation is essential and to operate independently in regard to these things which have to do with individual productive efficiency and self reliance—under banking control individual development will be forced into prescribed channels in all lines. Which course shall we choose?

WHAT OF THE FUTURE OF THE EASTERN FORESTS OF THE UNITED STATES?

By Hon. S. B. Elliott

Member of the Forestry Reservation Commission, Pennsylvania

This article has for its object to call attention to the supreme importance of the Eastern forest areas, and to the neglect and immediate need of formulating definite plans for their recovery and management on the part of professional men in order to secure public interest.

That the forests of the United States east of the foothills of the Rocky Mountains differ greatly from those west of that line no one acquainted with both will dispute. Not only is there a difference in the species of trees composing them, but the soil in which they grow and the climate surrounding them bear little resemblance to each other, while their present stages of exploitation and destruction are well nigh antipodal. Prior to the exploitation of the forests of our country the forest area east of the Rockies was far greater than that west; but now the area of unexploited forests is greater west of that line than east of it. Besides this the eastern ones have been, still are, and will continue to be, called upon to supply a much greater population with forest products, and these in greater range of use than those of the west; and that demand has reduced the eastern region to a much more exhausted condition than the other, with no let-up in the demand, or prospect of that demand diminishing; but, rather, it inevitably will be increased. That the restoration and maintenance in useful perpetuity of the eastern forests is a matter of supreme and vital importance to the whole country, and that importance an increasing one, admits of no truthful denial.

A large portion of the western territory still has upon it considerable virgin or untouched wildwood forests where any and every method for their maintenance in perpetuity that may be suitable to the varying conditions can be resorted to; and their treatment along practical lines can safely be left to educated foresters who, in the future, should, and doubtless will, have them in hand; but in the east there is comparatively little of such forests left, and what little there is is not likely to be treated or exploited with any view to restoration and useful perpetuity after exploitation; and hence any system having restoration and perpetuity in contempation must necessarily be along lines quite different in the east from what should prevail in the west. But what, if any-

thing, is being done about it? Is the restoration to a stand of valuable species of trees on this vast area of devastated and non-agricultural land a subject that is being lucidly and fully brought to the attention of the people and through them to those in charge of State and municipal affairs? For it should not be denied that if any great amount of restoration is to be accomplished such work must come first through governmental or municipal action; and those in control cannot be expected to act unless the people direct them to do so; and if educated foresters do not advocate prompt and effectual restoration of the forests of the east, and indicate how it can be brought about, what action can be expected of those who do not comprehend the condition of things along that line as should educated foresters?

Unfortunately, the general conception is that all that is needed to bring about restoration is to keep out fires—a something which everybody knows must be done no matter what system of restoration or management may be adopted—and Nature will promptly attend to the rest. While this would have been partially true in regions where the chestnut has been the prominent and prevailing tree, is it true at present, or likely to be in such regions, now that the fatal bark disease is rampant and wiping out the only tree that we have in the east that will throw up sprouts from a cut stump and become large enough for saw timber when the tree cut from which the sprouts spring is suitable for that purpose? Or is it true that natural regeneration can occur to any acceptable extent on any of the cut-over and burned-over eastern lands? And if so, should not the facts be known? Or if resort must be had to artificial restoration should not that be determined? Sooner or later the real facts should be ascertained and acted upon and why not begin the work at once? Surely it must come about at some time, and why delay? Dr. Fernow, in the University of California Journal of Agriculture, in speaking of general conditions throughout the country, recently said: "The restoration of these lands to useful production will be the task of the foresters, and within less than a generation this reconstruction work will be quite generally undertaken in all parts of the country." Whether or not this will prove a correct prophetic utterance I do not propose to discuss, but that it should so prove I most emphatically maintain; and if it is to prove true there should be prompt investigation of conditions; and where can come the benefit of delay in entering upon it, or, at least, why delay determining what must be done in the varying conditions which exist, when every day's delay adds to the burden of restoration?

The forestry schools of the United States are sending out annually scores upon scores of graduates, and what are they to do if the work of restoration of our eastern forests is not begun at once? And no one should dream that it will be entered upon unless the people at large are told what must be done and how it can be accomplished, and this information must come from those presumed to possess the knowledge that should guide in the matter.

If natural regeneration is to be depended upon, then let its advocates demonstrate that it should be. If such demonstration is undertaken it should, of course, be shown how long it will take to satisfactorily reforest a cut-over and burned-over tract where seed trees are few and scattering, if at all existent; how the seeds can escape destruction, or germination be secured; what control of the species can be had; how density of stand can be brought about; what will be the amount and character of the yield, and its cost; and all other things which may and unquestionably will arise in determining a correct or even approximately correct showing. Or if artificial restoration shall be advocated, then there should be shown cost for planting; the difficulties in securing a full stand; cost of thinning; time required for financial maturity to be reached; character, cost, and amount of yield, and all things necessary to reach a safe conclusion. And all this made so plain "that he who runs may read and understand."

To my mind, showing the necessity of and indicating the best methods to pursue in restoring the forests of the east are, today, the most important features to be considered in the study of American forestry, and are the ones that should be given precedence; for if ever delay is dangerous it will prove to be so in this case. Hence, hoping the matter will be discussed in the forestry literature of the country, and otherwise, I have penned the foregoing, and if it rouses anyone to even investigate conditions and suggest a method of action, something will have been accomplished—a something which does not now seem to be considered of much moment.

FOREST TERMINOLOGY

REPORT OF COMMITTEE

Three years ago the undersigned, then president of the Society of American Foresters and of the Canadian Society of Forest Engineers, inaugurated a committee to revise the terminology of the profession. The committee, with small changes, was continued through the next two administrations, and in the following pages is now making its final report on three sections of its work.

The fourth section of the committee's work, namely, that on Utilization and Protection, will be reported separately. It was considered that the terms used in logging could advantageously be published by themselves, these being terms which are merely recorded without controversy.

The terms of Protection were found to be in a process of growing, which made it desirable to postpone their compilation, and as they could also fitly be kept separate, this report deals only with forestry terms proper by themselves.

The composition of the committee is as follows: Subsection on Silviculture, Silvics, and Forest Description—S. N. Spring, Chairman, E. H. Frothingham, E. E. Carter, A. Gaskill, A. F. Hawes; Subsection on Organization, Mensuration, and Management—A. B. Recknagel, Chairman, W. B. Barrows, W. Drake, P. S. Lovejoy, D. T. Mason, T. S. Woolsey, Jr.; Subsection on Utilization and Protection—R. C. Bryant, Chairman, B. P. Kirkland, Dorr Skeels, T. S. Woolsey, Jr.; Subsection on Valuation, Administration, and General Terms—E. A. Ziegler, Chairman, H. H. Chapman, W. W. White, K. W. Woodward; Collating Subsection—B. E. Fernow, Chairman, C. D. Howe, Clyde Leavitt, W. N. Millar, Ellwood Wilson, J. H. White.

This committee of twenty-five was divided, as will be seen, into five sub-committees, four on as many groups of subjects and a collating sub-committee, whose function was to make final revision, securing amalgamation and bringing into concordance the findings of the various sub-committees.

The chairmen of the sub-committees, chosen from educational institutions, in which they teach the subjects assigned to their sub-committees, did the lion's share of the work, listing the terms falling under their scrutiny and consulting the members of their committees and others,

revising and finally deciding on definitions, and at last running the gauntlet of the collating committee.

It may, then, be said that the final report is the mature judgment, laboriously arrived at, by representative men of the profession, who by their occupation are in position to use the terminology systematically.

That even after this careful revision, omissions, discrepancies, and disagreements will remain is to be expected. Indeed, in a few instances differences of opinion as to proper usage could not be entirely settled even in the committee itself, the collating committee recording its disagreements, leaving it to further development in practical use as to which view will be preferred.

It should be realized that, after all, terms are nothing but language—terms are merely a device of shortening language—language is in part a matter of personal taste, of personal habit, and is also a matter of growth. Terms are convenient names for groups of things or of relations within certain limits (the word "term," indeed, meaning a "limit"). By extending the limits arbitrarily term language becomes unstable, unsafe and confusing. Especially in technical language a more precisely limited meaning given to terms is an advantage and leads to clearer thinking. To secure a uniform use of terms it is necessary to secure an agreement of those who use term language. Language being a matter of taste and growth, different people, and at different times, form the habit of using certain expressions to denote certain concepts. Once such a habit is formed, it is difficult to eradicate it because the personal element is strongly conservative. It will, however, be admitted that in scientific and professional work for the sake of clearness a uniform use of terms is desirable, and to render this possible—by no means to force it—an agreement must be reached and a definite meaning attached to each term. This is what the committee has attempted.

In doing it, it has as far as possible tried to ascertain the best usage and recorded it. It has almost entirely avoided the coining of new terms, not more than five terms being of that description. It has ruled out a number of terms that were introduced in Bulletin 61 (Bureau of Forestry) as either ill chosen or not necessary.

The principles which have guided the committee in choosing terms, where there was uncertain use, were formulated by the chairman as follows:

(*a*) A term should be necessary. As long as common language is sufficient to precisely state the idea, special terminology is superfluous, except, perhaps, for special cases or special writings. A corollary is

that, as long as an accepted term employed in other sciences or arts expresses precisely the conditions or ideas to be expressed, there is no gain in coining a new word.

(*b*) Words which are current with well-established meanings should not be employed as terms in another sense, especially where it is likely that ambiguity would be introduced by the simultaneous use of the ordinary sense and the term meaning.

(*c*) Age is a virtue: a long-established, sufficiently well-defined and understood term should not be lightly discarded or supplanted unless very considerable improvement were gained. Convenience, we repeat, is the object of language, and it is more convenient to use established language than to fish for new words.

(*d*) Terms should be as short and as nearly as possible self-explanatory. It is, of course, well nigh impossible, nor is it necessary, that a term explain all that is implied in it; it is the very impossibility of doing so that leads to the use of special terms which to the initiated at once convey the full explanation. But, if the term suggests its own explanation, it will be the more acceptable.

(*e*) Finally, the word or word combination should have a *term quality*. This is, perhaps, the most difficult requirement to define or to discover: it is like taste in art, it requires a language sense which by instinct or intuitively rejects the unsuitable. A word infrequently used in common language has thereby more term quality than one in common use; a Roman word more than a Saxon; a brief combination more than a long one; a compound more than a phrase; an unusual compound more than a common one.

Often commonplace language assumes a somewhat specialized meaning and has then been included in this list of terms. Occasionally even without this specialized meaning words have been admitted because their common sense is not quite clear. Whether to admit or exclude these has sometimes been a matter of controversy. The committee has, perhaps, erred more in omitting than in admitting such terms.

To those who find difficulty in accepting the committee's rulings, there are three ways open: to continue the use of their own terms until they find out their error; to use the synonymy, if it satisfies their taste better; to come forward with arguments for their own choice of other terms or of new terms, and in that way aid in the final acceptance and growth of the terminology.

For that end the committee is inclined to recommend the appointment of a standing committee on terminology.

For the committee,

B. E. FERNOW,
Chairman.

TORONTO, CANADA, *December* 26, 1916.

TERMS IN FORESTRY

COMPILED BY A COMMITTEE OF THE SOCIETY OF AMERICAN FORESTERS

Absolute forest land. Land fit only for forest growth.

Syn.: absolute forest soil. G., Absoluter Waldboden. F., sol forestier.

Absolute form factor. *See* Form factor.

Acid humus. *See* Humus.

Accretion. *See* Increment.

Advance growth. Young trees which have sprung up spontaneously in openings in the forest, or under the forest cover (before reproduction fellings are begun).

Syn.: volunteer growth.

G., Vorwuchs. F., semis préexistant.

Afforestation. *See* Forestation.

Age class. All trees in a stand or forest whose age falls within stated limits, usually divided in 20-year periods (5 years in coppice), but in old stands may be of wider range, and may be stated in extent of area or in percentage of the whole stand or forest, or, in selection forest, by number of trees. A stand in which the trees fall between the age of 1 to 20 years would be referred to as age class I. *See also* Development class.

G., Altersklasse. F., classe d'age.

Gradation of age classes refers more specifically to this formation of age classes. *See also* Tree class.

G., Altersabstufung. F., gradation d'age.

Distribution of age classes refers to either the *local* distribution of age classes (G., Verteilung der Altersklassen, Altersklassenlagerung); or to the percentic or absolute representation of the different age classes in area or amount, or (in selection forest) in number of trees (G., Altersklassenverhältniss).

Disruption of age classes refers to the attempt to provide safety against fire or insects, by locating the age classes in small areas.

G., Altersklassenzerreissung.

Normal age classes. *See* Normal.

All-aged forest. (*Obs.*) *See* Uneven-aged forest, Selection forest.

Annual plans. *See* Working plan.

Area tape. A tape from which the basal area may be read directly when it is placed around the tree.

Artificial reproduction. *See* Reproduction.

Aspect. The direction toward which a slope faces. The eight main points of the compass, N., NE., E., SE., S., SW., W., NW., are distinguished in forest description.

Syn.: exposure.

G., Lage. F., exposition.

Assortment. The classes of wood materials into which the harvested crop may be divided, as logs, fuel wood, pulpwood, railway ties, etc., or according to size into timberwood (stoutwood, above 3-inch diameter); brushwood (below 3-inch diameter); cordwood, split and billets, etc. *See also* Grading.

G., Sortiment. F., categorie.

Ball planting *See* Forest planting.

Bark blazer or **gouger.** *See* Scribe.

Barren. An area which is devoid of trees (moss barren), or bearing only stunted trees, then denoted by the character of the tree growth, as pine barren, oak barren, spruce barren.

Basal area. The area of a cross section of a tree, usually expressed in square feet, and usually referring to the section at breast-height. The sum of the basal areas of trees in a stand is the basal area of the stand, and is usually expressed in square feet per acre.

G., Stammgrundfläche. F., surface terrière.

Base capital. *See* Capital.

Biltmore stick. A graduated rule, usually of wood, the graduations of which indicate (when the rule is held tangentially to the tree) the diameter of the tree at the point where measured. The rule is constructed on the principle of similar triangles. *See also* Caliper.

Blank. An opening in the forest where, from any cause, very few or no trees are growing.

G., Blösse. F., vide.

Blaze, *v*. The process of marking a tree by means of a sharp instrument, removing part of the bark.

Blaze, *n*. A spot made on a tree by chipping off a piece of bark.

Block. *See* Under subdivision.

Blow-down. *See* Windfall.

Board foot. A unit of measurement represented by a board one foot long, one foot wide and one inch in thickness, or its equivalent in volume. In finished or surfaced lumber the board foot measure is based on the measurement before surfacing or other finishing, or on the superficial measure only.

Board measure. A term expressing the board foot content of round or manufactured timber; and for expressing the volume of logs, trees or stands in terms of the estimated amount of lumber which may be cut therefrom according to various log rules (*q. v.*). Usually abbreviated B.M.; units of larger quantities stated in thousands, are abbreviated M B.M.

Board rule. **1.** A tabular statement showing the board foot contents for various widths and lengths of squared timber, or of sawed timber.

2. A graduated stick for determining the contents of squared timber. The number of board feet in squared timber of given widths and lengths, or of sawed timber, is shown upon the rule. *See* Scale stick.

Syn.: lumber rule, lumber scale.

Board scale. *See* Board measure.

Bole. *See* Stem.

Border cutting. *See* Reproduction, Strip-selection method.

Breast-height. A height of 4½ feet above the average ground surface or above the root collar, the diameters of standing trees being ordinarily measured at this height (abbreviation d. b. h.).

G., Brusthöhe. F., hauteur d'homme.

Breast-height form factor. *See* Form factor.

Broadcast seeding method. *See* Direct seeding.

Broken. *See* Crown density.

Brushwood stage. *See* Development class.

Budget regulation. *See* Regulation of cut.

Bunch planting. *See* Forest planting.

Burn, *n*. An area over which fire has run to the noticeable injury of the forest.

Caliper, *n.* An instrument for measuring diameter of trees or logs. It consists usually of a graduated beam, at right angles to which are attached one fixed and one sliding arm. *See also* Biltmore stick and Tree compass.

G., Kluppe. F., compas forestier.

Caliper, *v.* To measure diameters.

G., Kluppieren. F., mesurer le contour.

Canopy. *See* Crown cover.

Capital. This factor of production in the forestry business is variously figured according to what parts of the investment are referred to and what basis of valuation is applied.

Fixed capital refers to such kinds of capital as are not used up in production, like the soil.

Working or *Operating capital* refers to money capital needed to supply current expenses in operating a forest.

Soil capital refers to the value of the soil figured in various ways.

Stock capital refers to the value represented by the wood material of all stands comprising a forest or working unit.

Forest capital refers to soil capital and stock capital combined.

Base capital may be used following the precedent of Pressler in his index percent for the combined soil and working capital.

These capitals may be based upon various kinds of values, and to secure a definite meaning, the term must be qualified by the method, by which its value was determined. *See* Value.

Chance. A term in common local use, more or less synonymous with Logging unit, which see. Not favored as a term in forest management.

Circumference tape. *See* Diameter tape.

Clean-boled. Being free or cleared of branches. Used to designate timber with a satisfactory length of clear bole.

G., Astrein. F., dépourvu de branches.

Clean cutting. *See* Reproduction, methods of.

Cleaning. *See* Intermediate fellings.

Clear and **Clearing.** **1.** Clearing in common parlance, an area from which all or nearly all forest growth has been removed.

2. The process of removing all of a mature crop or stand at one operation.

G., Schlagräumung. F., vidange.

3. The natural loss of branches through withdrawal of light.

Syn.: self-pruning.

G., Asterinigung. F., élagage naturel.

Clear length. That portion of the stem of a tree free from limbs from the ground to the lowest branch or branch stub.

Climax type. *See* Forest type.

Closed. *See* Crown density.

Co-dominant. *See* Crown class.

Compartment. *See* Subdivision.

Compartment system. (*Obs.*) *See* Reproduction methods, Shelterwood.

Composite forest. **1.** A forest in which both seedlings and sprouts are used in reproduction. The seedling growth forming the *overwood* or standards; the sprout growth, the *underwood.*

2. A forest of seedlings and sprouts grown up together naturally.
Syn.: sprout-seedling forest; coppice with standards.
G., Mittelwald. F., Taillis sous futaie ou composé.

Conservative lumbering. (*Obs.*) Has been used to designate any attempt to introduce into logging operations the idea of providing for a future crop, or at least a second cut.

Control book. *See* Working plan control.

Conversion, *n.* A change from one silvicultural method to another as from coppice method to high forest.
G., Überführung, Umwandlung. F., conversion.

Conversion period. The period during which the change from one system or method of silvicultural management to another is, or is to be, effected.

Coppice forest, coppice. A forest consisting wholly or mainly of sprouts.
Syn.: sprout forest.
G., Niederwald. F., taillis simple.

Coppice method. *See* Reproduction, method of.

Coppice shoot or **sprout.** A sprout originating from a coppice stock as opposed to a seedling stock. *See* Seedling sprout.

Coppice with standards. *See* Reproduction method and Composite forest.

Coupe (French). **Cutting** or **Cutting area.** Not favored as a term in forest management.

Cross section. A cut across the trunk or branch of a tree. *See* Basal area.
G., Querschnitt. F., section transversale.

Crown. In silvics, the upper part of a tree, including the living branches with their foliage.
G., Krone. F., cime.

Crown canopy. *See* Crown cover.

Crown class. All trees in a stand occupying a similar position in the crown cover. The crown classes usually distinguished are:

Dominant. Trees with crowns extending above the general level of the forest canopy and receiving full light from above and partly from the side; larger than the average trees in the stand, and with crowns well-developed but possibly somewhat crowded on the sides.

Co-dominant. Trees with crowns forming the general level of the forest canopy and receiving full light from above but comparatively little from the sides; usually with medium-sized crowns more or less crowded on the sides.

Intermediate. Trees with crowns below, but still extending into, the general level of the forest canopy, receiving a little direct light from above but none from the sides; usually with small crowns considerably crowded on the sides.

Overtopped. Trees with crowns entirely below the general forest canopy and receiving no direct light either from above or from the sides. These may be further divided into *oppressed*, usually with small, poorly developed crowns, still alive, and possibly able to recover; and *suppressed* or dying and dead.

Crown cover. The canopy formed by the crowns of all the trees in a forest, or, in an uneven-aged forest, by the crowns of all trees in a specified crown class.
Syn.: canopy, crown canopy, leaf canopy.
G., Kronendach, Beschirmung. F., couvert, voûte foliacée.

Crown density. An expression of the relation of crown area (or crown cover) to the land area involved, measuring the extent of shading exercised by the crowns, with due regard to the habit of the species, site, and age. It is usually expressed in decimal fraction of complete cover.

G., Beschirmungsdichte. F., épaisseur du couvert.

The degrees of crown density in a forest may be expressed by the following terms, and fraction of a full crown cover.

Closed: .8 to 1 (crown cover complete).

G., geschlossen. F., plein.

Dense: .6 to .8 of the ground shaded by the crowns.

G., dicht. F., dense.

Medium or *broken:* .4 to .6.

G., lückig. F., entrecoupé.

Open: less than .4 of the ground shaded by the crowns.

G., licht. F., clair.

Cruise. *See* Estimate.

Cull, *v.* **1.** To remove trees, especially merchantable ones, from a forest without regard to silviculture. *See* Lumber manufacturing terms.

2. In grading, to place in the lowest grade.

Cull, *n.* A low grade of lumber or a rejected tree in timber estimating.

Culled forest. *See* Cut-over forest.

Current increment. *See* Increment.

Cut, *n.* The amount of material cut or to be cut according to plan.

Syn.: felling budget.

G., Forstetat, Hiebssatz. F., budget des forêts.

Cut over, *v.* To cut most or all of the merchantable timber in a forest.

Cut-over forest. Forest from which most or all of the merchantable timber has been cut.

Syn.: logged-over.

Culled forest is a cut-over forest from which certain *species* or *sizes* only have been taken, *e.g.*, culled for pine and spruce.

Cutting. **1.** In nursery and planting practice a portion of the stem or root of a live tree used for propagation.

G., Steckreis. F., bouture.

2. The process of felling trees.

G., Schlag, Hieb. F., coupe, abatage.

3. An area on which the trees have been cut or are to be cut.

Syn.: cutting area; felling area.

G., Abhiebsfläche, Schlag. F., surface coupée.

Syn.: felling. There being a difference of opinion as to the preference between these synonyms in the sub-committee and the collating committee, the latter gives them equal value, recommending, however, the use of *felling* (as of greater term quality) wherever a substantive meaning is prominent and where real forestry terms are involved, as in severance felling, felling cycle, felling series, felling plan, reserving *cut* and *cutting* where the common verbal sense is prominent, as in cutting height, cutting limit.

Cutting area. *See* Cutting.

Cutting height. *See* Stump height.

Cutting limit. *See* Diameter limit.

Cutting plan. *See* Felling plan.

Cutting series. *See* Felling series.

Cutting cycle. *See* Felling cycle.

Damage cutting. *See* Salvage cutting or felling. New term.

Damping off. The succumbing of seedlings to a certain fungus disease.

Deforestation. A term used to indicate the denuding of a forest area.
G., Entwaldung. F., déboisement.

Dendrometer. An instrument combining height and diameter measure. Capable of measuring from the ground diameters at any point.

Dense, *a.* *See* Crown density.

Density of crop. *See* Stock density.

Development class or **stage.** Similar to age class and tree classes. Mere descriptive words may be used instead of age and measurement to designate a stage of development of a stand:

Seedling stage or seedling growth, a stand of seedlings.
Thicket stage or brushwood, a stand of saplings.
Polewood stage, a stand of poles.
Young timber stage, a stand of standards.
Old timber stage, a stand of veterans.

Diameter breast-high. The diameter of a tree at 4½ feet above the ground. (Abbreviation, d. b. h.). The additional abbreviations *o. b.* and *i. b.* are used to designate whether the diameter is measured outside or inside the bark.

Diameter class. All trees of a stand whose breast-high diameters fall within prescribed limits, the intervals varying usually from 1 to 4 inches, fractions being rounded off to the nearest full inch of the limit. The diameter classes may be stated by numbers of trees in each class on the unit of area or by the percentage of the total contents of the stand represented in each, or by area occupied, or in any other way. Diameter classes take the place of age classes in the selection forest.
G., Stärkeklasse. F., catégorie de grosseur.

Distribution of diameter classes. In its strict sense, the location and area of each stand of a given diameter class in the forest; in a general sense, the per cent of area occupied by each diameter class in the stand.

Diameter growth. *See* Increment.

Diameter limit. The smallest (and occasionally largest) size to which trees or logs are to be measured, cut, or used. The points to which the limit usually refers are stump, breast-height, or top.

Diameter tape. A tape from which the diameter may be read directly when it is placed around the tree.

Dibble, *n.* A tool for making holes for planting seeds or young trees.
G., Setzpfahl. F., plantoir.

Dibble in, *v.* To plant seeds or young trees in holes made with a dibble.

Die hammer. *See* Marking hammer.

Direct seeding. A method of establishing a forest artificially by sowing seeds on the area to be forested.

Broadcast seeding method is an application of direct seeding in which seeds are sown over the entire area to be forested.

Partial seeding may be done in strips, furrows or trenches, plats or spots (*see* Seed spot.)

G., Saeen, Saat. F., ensemencement, semis.

Disengagement cutting or **felling.** *See* Intermediate cuttings.

District, *v*. To make a subdivision of a forest into units on map or ground.
Syn.: divide.

District, *n*. An administrative subdivision. *See* Subdivision.

Dominant. *See* Crown class.

Duff. *See* Forest floor.

Empirical yield table. *See* Yield table.

Equalization period. The period during which it is planned to attain approximately normal stock conditions.
G., Einrichtungszeitraum.

Estimate, *v*. To determine the approximate contents of trees or stands of timber.

Estimate, *n*. An approximate determination of size, contents, value or anything else; more specifically of the volume of a tree or stand.
Syn.: cruise.

Even-aged. Applied to a stand in which only small age differences appear, differences varying with the average age of stand. In young stands, age differences should not be more than 10 or 20 years; in mature stands, not more than 30 or 40 years.
G., gleichalteriger Bestand. F., peuplement uniform.

Expectation value. *See* Value.

Exposure. *See* Aspect.

Factors of locality. *See* Site.

Fail spot or **place.** A place where natural or artificial reproduction has failed.
G., Fehlstelle. F., vide.

Felling. Syn.: cutting. The term *felling* is preferred by the collating committee for its better term quality, especially where substantive meaning is prominent *See under* Cutting.

Felling age. *See* Rotation.

Felling area. An area on which the trees have been cut or are to be cut.

Felling budget. *See* Cut.

Felling cycle. The planned interval between fellings or cuts on the same forest area. *See also* Reproduction, Selection method.
Syn.: period of return.

Felling plan. *See under* Working plan.

Felling series. An aggregation of stands into a proposed or actual sequence of felling areas, the object being a distribution of felling areas for administrative reasons or to secure a final satisfactory distribution or location of age classes, especially to avoid damage by windfall and insects due to uniformity of stand and size of felling area. It is intended to interrupt a regular sequence of age classes.
Syn.: cutting series.
G., Hiebszug. F., série de coupes.

Final cutting. *See* Reproduction, Shelterwood method.

Final yield. *See* Yield.

Financial maturity. *See* Maturity.

Financial rotation. *See* Rotation.

First growth. *See* Old growth.

Forest, *n*. In common usage, a large tract of land covered with trees; more exactly, a tract of land, more or less extensive, covered more or less densely with trees of

useful character, viewed from the standpoint of economic use and development. A species of *woodland* or *woods*, which is the generic term for the wooded condition of the land.

Timberland or *Timber* is used to designate ability to furnish at once logs or material for commercial purposes.

Woodlot. Any small tract of forest, usually the forested portion of a farm.

Forest. In finance, refers to the combination of soil and stand.

Forest, *v.* To establish a forest either by natural or artificial means.

Forest capital. *See under* Capital.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest economics. A comprehensive term including all matter referring to the position of forests in public affairs.

Forest economy. A comprehensive term including all matter dealing with the business aspects of forest management.

Forest expectancy value. *See under* Value.

Forest finance. That branch of the science of forestry which relates to the forest as an investment. It includes two distinct subjects, forest valuation and forest statics; the first concerning itself with valuations of soil and growing stock, increment, and damage; the second concerns itself with a comparison of the financial results of different methods of treatment and other questions of profitableness and financial effects.

G., Waldwertrechnung = forest valuation; forstliche Statik = forest statics.

Forest fire. *See under* Protection terms.

Forest floor. A term used in forest description to designate only the deposits of vegetable matter on the ground in a forest.

Litter includes the upper, but slightly decomposed portion of the forest floor; *humus*, the portion in which decomposition is well advanced. *See* Humus. An intermediate layer of more or less decomposed organic matter below the litter may be designated as *duff*.

Forest influences. All effects resulting from the presence of the forest upon health, climate, streamflow, and economic conditions.

Forest inventory. *See* Forest survey.

Forest management. The practice or application of forestry in the conduct of the forest business.

G., Forstbetriéb. F., exploitation des forêts, aménagement.

The collating committee prefers to see the term used as defined, instead of as an equivalent to forest economy as a collective name for the subjects which deal with business problems (*see* Forestry) as separated from forest crop production.

Forest mensuration. That branch of forestry which deals with the determination of the volume of stands, trees, logs and other timber products, and with the study of growth and yield of trees and stands.

G., Holzmesskunde. F., dendrométrie.

Forest organization. The branch of forestry which concerns itself with the organization of a forest property for management and its maintenance, ordering in time and place the most advantageous use of the property, with the ultimate aim of securing a sustained yield.

Syn.: forest regulation.

G., Betriebsregulierung, Forsteinrichtung. F., aménagement.

Note: In the past both forest regulation and forest organization have been used indiscriminately. In the absence of any English word exactly equivalent to the German "*Forsteinrichtung*," both terms may well continue to be used.

Forest per cent. In finance, the rate of interest earned by the forest capital. Current annual forest per cent (index per cent) and mean annual forest per cent are distinguished.

In economics, the proportion of land of a given State or country covered by forest.

Forest plantation. Forest growth established by setting out young trees or by sowing seed.

G., Pflanzung, Kultur. F., plantation.

Forest planting. The artificial establishment of a forest by setting trees, or with certain species by planting cuttings. In general sense including also direct seeding (*quid vide*). Terms of forest planting are as follows:

Planted and *Planting area.* Land which has been artificially stocked with forest trees, or is to be so stocked.

Planting plan. A detailed scheme for forest planting on a given area.

Planting stock. Trees or cuttings used in forest planting. The age and history of the trees are indicated by figures, *e.g.*, 2–0, two-year-old seedlings, or 2–1, two-year-old seedlings which have remained one year in transplant beds or rows.

Ball planting. A method of transplanting young trees with balls or lumps of earth around the roots.

G., Ballenpflanzung. F., plantation en motte.

Bunch planting. (*Obs.*) A method of planting in which two or more plants are set in one hole.

Hole method. A method of planting forest trees in which the trees are set in a hole; to be distinguished from the slit method.

G., Lochpflanzung. F., plantation par potets.

Slit method. A method of forest planting in which a slit or cleft is made with the planting tool, the tree inserted and the soil firmed into place after withdrawal of the tool; to be distinguished from the hole method. According to the implement in use, the method is designated mattock-slit or spade-slit, etc.

G., Klemmpflanzung, Spaltpflanzung. F., plantation en fente.

Mound planting. A method of planting on wet ground, in which the seeds or young trees are planted on mounds, ridges, or hills.

Syn.: hill planting, ridge planting.

G., Hügelpflanzung. F., plantation en buttes.

Row planting. An arrangement of trees in forest planting in which they are set in rows.

Syn.: regular planting.

G., Reihenpflanzung. F., plantation en lignes.

Trench planting. A method of planting in which the young trees are set in trenches or furrows.

Pit planting when plants are set in small depressions or pits instead of continuous trenches.

Syn.: furrow planting.

Repair planting. After-culture, filling out fail places by planting.

G., Nachbesserung. F., regarnissage.

According to the arrangement, row planting is designated as follows:

Rectangular planting. An arrangement in which the trees are set at the corners of successive rectangles.

G., Quadratpflanzung, Quadratverband. F., plantation en carré.

Triangular planting. An arrangement in which the trees are set out at the corners of successive triangles.

G., Dreieckverband. F., plantation en triangle.

Quincunx planting. An arrangement in which the trees are set in the center and at the corners of successive squares.

G., Fünfverband, Kreuzpflanzung. F., plantation en quinconce.

Seeding lath, seeding trough. Planting tools used to secure an even distribution of seed in drills of the seed bed (nursery practice).

Seed horn, seed flask, etc. Planting tools designed to distribute a uniform amount of seed in direct seeding in seed spots.

Forest policy. The attitude toward forests and general method of administration of public interests in forests by the State.

Forest regulation. *See* Forest organization.

Note: In the past both forest regulation and forest organization have been used indiscriminately. In the absence of any English word exactly equivalent to the German "*Forsteinrichtung*," both terms may well continue to be used.

Forest rent. *See under* Rent.

Forest rental value. *See under* Value.

Forest survey. The gathering and tabulation of all data in regard to forest lands including plane and topographic surveying, mapping, timber estimates, forest description, grazing data and land classification, type and site determination, involving all the work of every kind (including the construction of volume, growth and yield tables) necessary for the making of a working plan. Forest surveys may be partial or complete, more or less intensive or extensive, and of varying degree of accuracy.

Syn.: stock-taking in part.

Forest tree nursery. An area upon which young trees are grown for forest planting.

Seedling and *Transplanting nursery*, permanent and temporary, may be distinguished.

G., Saatkamp, Baumschule. F., pépinière.

Forest type. A descriptive term used to group stands of similar character as regards composition and development due to given physical and biological factors, by which they may be differentiated from other groups of stands. The term suggests repetition of the same character under similar conditions.

A type may be termed *temporary* to express the expectation of a change, if its character is due to passing influences (logging, fire, etc.); *permanent* if no change is expected and the character is due to physical and biological (natural) factors alone; *climax* if it is intended to indicate the character as the ultimate stage of a succession of temporary types.

A *Cover type* is a forest type now occupying the ground, no implication being conveyed as to whether it is temporary or permanent.

Forest utilization. That branch of forestry which concerns itself with the operation of harvesting and marketing the forest crop and other resources of the forest.

G., Forstbenutzung. F., technologie forestière.

Forestation. The establishment of forest naturally or artificially upon areas where it is at present absent or insufficient. If distinction is desired, "*afforestation*" may be used to designate the planting of open ground, "*reforestation*" to designate previous wooded condition.

Forester, *n.* **1.** One who is trained to practice forestry as a profession.

G., Forstmann. F., forestier.

2. A title or designation of position.

Forestry. The science and art of managing forests in continuity for forest purposes, *i.e.*, for wood supplies and forest influences.

G., Forstwirtschaft, Forstwesen, Forstwissenschaft. F., science forestière, foresterie.

The main branches of forestry are Forest policy, Silviculture, Forest economy or Forest management (*q. v.*) (including Forest mensuration, organization or regulation, administration and finance), Forest protection and Forest utilization.

Form class. Classification of trees according to taper, from very tapering to full-boled (for use with Schiffel's form quotient.)

Form constant. The numerical difference between the form quotient and the form factor ($C=Q-F$). The form constant remains practically the same for a given species, no matter of what height or diameter.

Form factor. The form factor of a tree is the ratio between its volume and that of a geometric solid, usually a cylinder, having the same diameter and height. The volume of the solid (or cylinder) is taken as a unit, "1," the volume of the tree or trees is expressed as a decimal. Form factors are classified according to the point of diameter measurement (base, d. b. h., top), the portion of the tree included (tree-stem, merchantable portion, etc.), the geometrical figure used as a basis of comparison (cylinder, cone, frustum), the unit of measure used (cubic foot, foot B. M.), and may refer to single trees or stands. In this classification eleven qualifications have been so far considered. Common usage implies breasthigh measurement, cylindrical comparison, cubic foot unit and single stems. The term *Absolute form factor* is used if the base diameter is measured at the base of the tree; *Normal form factor*, if the measurement is made at a varying height which bears a constant ratio to the total height of the tree.

G., Formzahl. F., coefficient de forme.

Form height. **1.** The product of height and form factor, tabulated for convenience of calculating cubic contents of trees or stands.

G., Formhöhe, Richthöhe.

Form quotient. The quotient of the breasthigh diameter of a tree into the diameter measured at any height above the d. b. h., usually at ¼, ½, or ¾ of the height of the tree.

Freeing (setting free). *See* Intermediate (disengagement and liberation) cutting.

Fully stocked. The condition of a stand containing as many trees or material as it normally can for the species, site, and age. *See* Stock, Overstocked.

Full-boled. As applied to the trunk of a tree, approaching the cylindrical form. *See* Form class.

G., vollholzig. F., à fut soutenu.

Gradation of age classes. *See* Age class.

Grading. In description, mensuration, and utilization the process of differentiating the crop into assortments (*q. v.*) or classes of material.

Ground cover. A term used in forest description to designate all herbaceous plants growing in a forest; such as ferns, mosses, grasses, and weeds.

G., Bodendecke. F., couverture du sol.

Group method. *See* Reproduction method.

Growing stock. *See* Stock.

Growth. *See* Increment.

Growth table. A tabular statement showing the growth data of individual trees or stands. *See* Increment.

Habit. The general form or arrangement of stem, roots, and branches, or of the entire tree, possessed in common by a species in a given habitat.

Heel in, *v.* To store young trees prior to planting by placing them against the side of a trench and covering the roots with earth.

Height class. One of the arbitrary divisions of the trees of a stand on the basis of height. The division is usually by intervals of 10 feet.

G., Höhenklasse. F., classe de hauteur.

Height measure. *See* Hypsometer.

High forest. A forest originating from seed.

Syn.: timber forest.

G., Hochwald; Samenwald. F., futaie, haute futaie.

Hole method. *See under* Forest planting.

Hold-over. A tree reserved from harvest to grow through a second rotation. *See* Reserve.

G., Ueberhälter. F., reserve.

Humus, *n.* That portion of the forest floor (*q. v.*) in which decomposition of the litter is so far advanced that its original form is not distinguishable. Humus in a condition favorable to forest growth is said to be *mild*, *neutral*, or *sweet*. Humus harmful to forest growth, owing to the presence of humic or similar acids or colloids produced by decomposition under excess of moisture and lack of air, is said to be *sour*. Humus incompletely decomposed is called raw humus.

G. and F., Humus.

Hypsometer. An instrument for measuring heights, especially of trees.

Improvement felling. *See under* Intermediate cuttings.

Income. In forest finance, the *gross* income represents money returns from which no expenses have been deducted; *net* income results by deducting all actual expenses charged in book account, including interest on borrowed capital, but not the *calculated* interest on investment, which enters in determining *profit*.

G., Geldertrag, Einkünfe, Erlös. F., revenu.

G., Rohertrag, Rohgeldertrag, Brutto Geldertrag, Erlös im Ganzen, Gesamtgeldein nahmen.

Final income, returns from final harvest.

G., Haubarkeitsertrag, Abtriebsertrag.

Intermediate income, returns from stands not yet mature.

G., Nebennutzungs-, Zwischennutzungs-, Vornutzungs-ertrag, -geldertrag.

Income rotation. *See* Rotation.

Income table. *See* Yield table.

Increment. Syn.: accretion.

The increase in diameter, sectional, basal area, height, volume, quality or value of a tree or stand. If distinction between the two terms is desired, *accretion* should be reserved for directly measurable, *increment* for calculated increases.

G., Zuwachs. F., accroissement.

Increment is differentiated with reference to time as *current annual increment* = the increment for a specific year (abbreviation, *c. a. i.*) (G., laufend jährlicher Zuwachs); *periodic increment* = the increment during a specific period of years; *mean annual increment* (*m. a. i.*) = the total increment divided by the age (G., Gesammtalterszuwachs); *periodic annual increment* (*p. a. i.*) = the increment for a specified period of years divided by the number of years in the period; usually used in lieu of the current increment (G., periodischer Durchschnittszuwachs).

Quality increment is the increase in value per unit of volume due to its augmented intrinsic worth with size or age.

G., Qualitätszuwachs.

Price increment is the increment in the sale value of forest products independent of quality increment, due to market conditions.

G., Teuerungszuwachs.

Value incremert is the increase in value of a tree or stand due to combined volume, quality and price increment.

G., Wertszuwachs.

Increment may be expressed in absolute numbers or as increment per cent per annum based on present or on past quantity as 100.

See also Index per cent.

Increment borer. An instrument for determining the rate of growth in diameter of standing trees. It consists of a hollow auger, which, when bored into a tree at right angles extracts a core on which the annual rings show.

Syn.: accretion borer; Pressler borer.

G., Zuwachsbohrer. F., sonde de Pressler.

Index per cent. The increase in value of a tree or of a stand, due to the combined volume, quality and price increments, expressed as an annual per cent of its present value. The interest rate at which a given stand pays interest by its value increment on its current value plus Base capital (*q. v.*) as capital; used to determine financial maturity or felling age by comparison with a demanded business rate.

G., Weiserprozent; Forstprozent. F., taux maximum du revenu.

Index stand. A mature stand used as a basis for conclusions, or an index of condition (volume) of the stand in former years, or of other immature stands, on the supposition that the stems of the mature stand represent the dominant stand of the earlier periods on the same site.

G., Weiserbestand. F., peuplement type.

Index tree. A mature tree utilized as an index of condition of immature trees. *See* Index stand.

Interlucation. New term. A severe opening up of a stand to light beyond the degree of severe thinning in order to secure a large increase of diameter on the remaining stand before final harvest. Usually accompanied by underplanting. *See* Intermediate cuttings.

Intermediate. *See* Crown class.

Intermediate. Refers to operations or occurrences taking place during the rotation before the final harvest of a stand, such as Intermediate cuttings or fellings (*q. v.*), Intermediate yield or Income or Returns.

Intermediate cuttings or fellings. Cuttings made in a stand between the time of its formation and its final harvest. It includes cleanings, improvement cuttings and thinnings.

G., Zwischennutzung; Vornutzung. F., exploitation intermédiaire.

Cleaning. Cutting made in a stand not yet past the sapling stage for the purpose of removing trees of undesirable form or species, which are injuring or are likely to injure those of greater promise.

Syn.: weeding.

G., Reinigungshib, Durchplaenterung, Durchläuterung. F., coupe de nettoiement.

A disengagement cutting or *felling.* A cleaning in a stand of small saplings with the specific purpose of checking or removing trees of undesirable species which are overtopping desirable trees or may later shade them.

G., Kronenfreihieb. F., dégagement de la cime.

Improvement cutting or *felling.* A cutting in a forest which has passed the sapling stage, the main object being to remove trees of undesirable form, condition and species. It is always a felling for the purpose of bringing the stand into better condition and composition for silvicultural management.

G., Verbesserungshieb. F., coupe d'amélioration.

Salvage cutting or *felling.* Removal of trees killed or injured in a forest by fire, insects, fungi, or other harmful agencies, with the purpose of utilizing merchantable material and preventing the spread of insects and disease.

G., Totalitätshieb. F., coupe accidentelle.

Liberation cutting or *felling.* Is an improvement cutting by which young growth is freed (set free) from oppression by removal of wolf trees.

G., Freistellen. F., dégager.

Severance felling or *cutting.* The clearing of a narrow strip on the border of a young stand to stimulate the root development and retention of branches of the bordering trees, producing a windfirm mantle, and thus preparing them for subsequent exposure to wind when an older stand on the windward side of the strip has to be removed before the utilization of the younger stand.

Thinning. A cutting made in immature stands after the sapling stage for the purpose of increasing the rate of growth of those trees which are left.

G., Durchforstung. F., éclaircie.

Degrees of thinning are indicated by the following grades. They may be gauged by volume and by number of trees removed.

Grade A—light. A removal of dead and dying trees.

Grade B—moderate. A removal, in addition, of all suppressed trees and the poorest intermediate trees.

Grade C—heavy. A removal, in addition, of the rest of the intermediate class of trees.

Grade D—very heavy. A removal, in addition, of many of the co-dominant trees.

German and Austrian experiment stations recognize four grades; Gayer[1] recognizes three grades, as follows:

Light (G., Schwach). Removal of dead and wholly suppressed.

Medium (G., Mittelstark). Removal of suppressed and the greater portion of the dominated trees (intermediate class).

Heavy (G., Stark). In addition, cutting operations in the co-dominant class.

Interlucation. A severe opening up of a stand. *See* fuller definition under its letter.

Selection thinning. A thinning in which always the stoutest trees are removed, as in the selection method of regeneration (Borggreve).

[1]*Der Waldbau*, Dr. Karl Gayer, Berlin, 1888.

Intermittent management. The management of a forest for a periodic instead of annual yield.
G., Aussetzender Betrieb.

Interplant. To set out young trees among existing young seedling growth, planted or natural; applicable also to planting land partly occupied by brushwood.

Intolerant. Incapable of enduring much shade, varying with species, age, and site.
Syn.: light demanding.
G., lichtbedürftig. F., tempérament robuste.

Large pole. *See* Tree class.

Large sapling. *See* Tree class.

Lath screen. *See* Shade frame.

Leader. The terminal shoot of the main stem.

Leaf canopy. *See* Crown cover.

Leaf litter. *See* Forest floor.

Leaf mold. *See* Humus.

Liberation cuttings. *See* Intermediate cuttings.

Lift, *v.* To loosen and remove seedlings from the seedbed in a nursery.

Light-demanding. *See* Intolerant.

Litter. *See under* Forest floor.

Locality. *See* Site.

Log rule. **1.** A tabular statement indicating the estimated or calculated amount of lumber which can be sawed from logs of given lengths and diameters.
2. A graduated rule (usually made of wood) for measuring the diameters and volumes of logs, the number of board feet in logs of given diameters and lengths being shown upon the rule. (Usually called Scale stick (*q. v.*)).

Log scale. *See* Scale stick.

Logging unit. A part of a forest which can conveniently be made the basis of an individual logging operation.
Syn.: chance; logging chance.

Lot. *See* Subdivision.

Low pole. *See* Tree class.

Lumber rule. *See* Board rule.

Lumber scale. *See* Board rule.

Management. *See* Forest management.

Marginal seeding. *See* Reproduction (strip) method.

Marking hammer. A tool used for marking trees or logs or other products with various characters, signs, numbers, etc.

Mature forest. A forest or stand which has reached its age of utilization (commercially). The meaning of maturity differs with the object of management, and to the forester is a matter of calculation on various bases. Biologically, maturity would refer to the age of seed production; physically, to cessation of height growth. Financial maturity is attained when the highest forest income or interest (which occurs when the index per cent is equal to the demanded business per cent), or forest rent, or soil rent, or otherwise financially best results can be secured. After this point of maximum result is passed the forest income decreases and the forest is said to be "financially overmature." *See also* Rotation.
Syn.: ripe.
G., finanzielle Hiebsreife.

Mean annual forest per cent. *See* Forest per cent.

Mean annual increment. *See* Increment.

Mean sample tree. A tree of representative form which in diameter, height, and volume is an average of the trees in a group or stand.

Medium. *See* Crown density.

Merchantable. A term to designate the portion of trees or stands which can be marketed under given economic conditions, usually refers to log material only.

Merchantable length refers to the marketable length of log in a tree.

Merchantable volume refers to the marketable volume.

Merchantable form factor. *See* Form factor.

Middle forest. (*Obs.*) *See* Composite forest.

Mild humus. *See* Humus.

Mixed forest. Forest composed of trees of two or more species. In practice usually a forest in which at least 20 per cent are trees of other than the leading species.

G., gemischter Bestand. F., peuplement mélangé.

Model forest. *See* Normal forest.

Mother tree. *See* Seed tree.

Mound planting. *See* Forest planting.

Natural pruning. *See* Pruning.

Natural reproduction. *See* Reproduction.

Net income. *See* Income.

Normal. Used as in common parlance in varying sense as conforming to a standard, rule or principle, a model, or as denoting an average of conditions, or the best of conditions.

G., normal. F., normal.

Normal age classes. The presence of a complete series of age classes corresponding to the rotation (*see* Age class).

Normal age class distribution. Such distribution of age classes as will permit annual or periodic fellings to be made without damage to adjoining stands.

Syn.: normal age class arrangement.

Normal increment. The best average increment attainable by given species on given sites, as represented in normal yield tables.

Normal forest. A standard with which to compare an actual forest to bring out its deficiencies for sustained yield management; the conception of an ideally regulated or organized forest; a forest with normal increment, normal age classes in size and distribution, and normal stock.

Normal growing stock or *Normal stock.* The amount of material represented by the stands in a normal forest; practically, the contents of the normal age classes as represented in normal yield tables.

Normal yield table. An accepted standard yield table with which to compare actual yields. The statements of a normal yield table are derived as an average from the best producing fully stocked areas for given species and sites. If a normal forest were not merely an idea, but actually attainable, the normal yield table would represent its productivity and stock.

Normal stand. A stand fully stocked and in proper growing conditions, conforming to the yield table and having normal increment.

Normal form factor. *See* Form factor.

Nurse tree. A tree which protects or fosters the growth of another in youth.

G., Schutzholz. F., essence d'abri.

Nursery. *See* Forest tree nursery.

Old growth. *See* Virgin forest.

Open, *a.* *See* Crown density.

Oppressed. *See* Crown class.

Organization. *See* Forest organization.

Over-cut. The cutting of a quantity of timber in excess of the annual growth of the forest or of the annual felling budget.

Overmature forest. Forest on which, as the result of age, growth has almost entirely ceased, and decay and deterioration have begun. *See also* Mature forest.

Over-stock. A growing stock greater than the normal growing stock. In natural regeneration, a condition of an excessive number of individuals hindering each other in development and retarding desirable differentiation into crown classes.

Overwood. *See* Composite forest.

Park forest. A forest in which the trees stand apart from one another or in detached groups. A very open forest in which usually also the characteristic forest floor is replaced by grasses.

Periodic annual increment. *See* Increment.

Periodic increment. *See* Increment.

Permanent type. *See* Forest type.

Physical factor. Any inorganic component of a site capable of influencing its forest-producing power, such as altitude, slope, aspect, soil, and subsoil. *See* Site.

Physical type. *See* Site.

Pit planting. *See* Forest planting.

Planted forest. *See* Forest plantation.

Planting area. *See* Forest planting.

Planting board. *See* Transplant board.

Planting plan. *See* Forest planting and working plan.

Planting stock. *See* Forest planting.

Pole. *See* Tree class.

Polewood. *See* Development class.

Pollard, *n.* A tree whose crown has been cut back to invite the production of shoots.

G., Kopfholz. F., têtard.

Pollard, *v.* Lopping the top of a tree to invite the production of shoots from the top.

G., köpfen. F., éteter, écimer.

Possibility. (*Obs.*) *See* Regulation of cut.

Preparatory cuttings. *See* Reproduction, Shelterwood method.

Preparatory stage. *See* Reproduction, Shelterwood method.

Present yield table. (*Obs.*) *See* Yield table.

Price increment. *See* Increment.

Profit. *See* Income.

Progress map. *See* Working plan control.

Protection forest. A forest whose chief value is to regulate streamflow, prevent erosion, hold shifting sand, or exert any other indirect beneficial effect. It may or may not produce timber.

G., Schutzwald, Bannwald. F., forêt de protection.

Pruning or **clearing,** *n.* The removal of branches from standing trees by natural (self-pruning) or artificial means. The clearing of the stem through the death and fall of branches for want of light is known as *natural pruning*, or *clearing* (*q. v.*).

G., Astreinigung. F., élagage natural.

G., Aufästung; F., élagage, terms of artificial pruning.

Puddle, *n.* A mixture of soil and water about the consistency of cream in which the roots of young trees are dipped to retard drying out during planting.

Puddle, *v.* To dip the roots of young trees in a mixture of soil and water.

Pure forest. Forest composed principally of trees of one species. In practice usually a forest in which 80 per cent or more of the trees are of one species.

G., reiner Bestand. F., peuplement pur.

Quality increment. *See* Increment.

Quality of site. *See* Site and Site class.

Quality of stand. The quality of stand is its actual condition from the viewpoint of production as compared with normal condition.

G., Bestandesbonität. F., qualité du peuplement.

Quincunx planting. *See* Forest planting.

Range. *See* Subdivision.

Reconnaissance. A preliminary, extensive forest survey *of a limited degree of accuracy.*

Reforest, *v.* To renew a forest, either by natural or artificial means.

Syn.: restock.

G., aufforsten. F., reboiser.

Reforestation. The natural or artificial restocking of an area with forest trees; most commonly used in reference to the latter. *See* Forestation.

G., Aufforstung. F., reboisement.

Regeneration, *n.* *See* Reproduction.

Regeneration period. *See* Reproduction period.

Regulation of cut. The fixation in advance of the annual or periodic cut, which in the normal forest would be equivalent to the annual growth. *See* Cut.

Syn.: regulation of felling budget; regulation of yield.

G., Etatsbestimmung, Ertragsbestimmung. F., fixation de la possibilité.

The following classification of methods of regulating the cut may be recognized:

Allotment methods, when a rotation is fixed and for a given year or period of the rotation a certain area, a certain amount of stock, a certain number or size of trees is allotted to be cut.

Normal stock or *Formula methods*, when the amount of cut is determined by comparison of actual with normal conditions and the cut is in part regulated by a volume formula for a rotation or equalization period.

Individualizing or *Stand methods*, when each stand is investigated for its financial maturity and designated for cutting, provided other age classes are in existence to assure continuity of crops.

Removal cutting. *See* Reproduction, Shelterwood method.

Removal stage. *See* Reproduction, Shelterwood method.

Rent. In forest finance, the income per acre secured as an annual return from a forest or stand under management, calculated either as forest rent or soil rent.

Forest rent is the net income (*q. v.*) from a forest organized for sustained yield, without interest charges on the forest capital—bookkeeper's balance—the forest,

i.e., soil with a stand or growing stock, being conceived as the forest capital, and the rent as the total interest earned by it.

G., Waldrente.

Soil rent is that part of the income (or balance) from a managed forest which remains as interest on the soil capital alone after all expenses with compound interest have been deducted, the soil alone being conceived as the capital.

G., Bodenrente.

Reproduction. **1.** The process by which a forest is renewed.

Natural reproduction is the renewal of a forest by self-sown seeds or by sprouts. *See also* Advance growth.

Syn.: regeneration.

G., natürliche Verjüngung. F., régénération naturelle.

Artificial reproduction is the renewal of a forest by direct seeding or planting.

Syn.: reforestation.

G., künstliche Verjüngung. F., régénération artificielle.

The collating committee recommends the use of plain *regeneration* for natural reproduction and *reforestation* for artificial reproduction.

2. Seedlings or saplings from sprouts or from self-sown seed.

Syn.: young growth.

Reproduction cutting. (*Regeneration cutting.*) Any cutting intended to invite or assist regeneration.

G., Verjüngungshieb. F., coupe de régénération.

Reproduction method. (*Regeneration method.*) An orderly procedure or process by which a forest is renewed or established, either naturally or artificially. The following methods may be distinguished:

1. Clearcutting, with artificial reproduction.
2. Clearcutting, with natural regeneration.
3. Seed tree method.
4. Selection.
5. Shelterwood.
6. Coppice.
7. Coppice with standards—Composite forest.

These methods are defined and explained as follows:

1. *Clearcutting with artificial reproduction.* Removal of the entire stand in one cut with artificial reproduction or reforestation by direct seeding or by planting (*q.v.*) *See also* Seed tree method.

G., Kahlschlagwirtschaft. F., méthode par coupe unique.

2. *Clearcutting, with natural reproduction.* Removal of entire stand in one felling, regeneration taking place by seed from the marginal stand or seed in the ground. Differentiation may be made according to the form of felling area into strip and group method.

Strip method. Cutting a strip, and, when regeneration has taken place by marginal seeding, *seaming* an additional strip and proceeding in this manner from year to year or period to period. A variant called *Strip method in echelons* (G., Kulissenhieb, Springschlag. F., coupe par bandes alternes) opens strips in several places at the same time and then proceeds similarly by seaming.

G., Saumhieb. F., coupe par bandes.)

Group method. Proceeds by removing groups of trees making more or less irregular openings and enlarging these until the entire stand is removed.

G., Kesselhieb, Löcherhieb. F., coupes par trouées.

3. *Seed tree method.* Removal of the entire stand at one cut, but leaving a small number of seed trees singly or in small groups, to be eventually removed. If the seed trees are held over for another rotation, this may be called *Reserve tree method.*

G., Ueberhaltbetrieb. F., traitement en futaie avec reserve sur coupe définitive.

4. *Selection method.* That method of cutting in which single trees, usually the largest, or small groups of such trees, are removed and reproduction secured under the remaining stand and in the openings. When groups of trees are taken, it is termed *Group selection method.* A special form of the selection method is termed *Selection border felling* or *strip selection* (G., Blendersaumschlag) when selection fellings are made in narrow strips, in most instances beginning on the north border and progressing southward, followed by clear cutting when young growth is fairly established with the expectation of additional marginal seeding. The resulting forest is uneven-aged in narrow lines.

G., Plenterbetrieb, Femelbetrieb. F., jardinage, régime de la futaie jardinée.

5. *Shelterwood method.* A method of securing natural reproduction under the temporary shelter of the seed tree crown cover, by means of a series of cuttings throughout the stand, aimed to admit a gradually increasing supply of light to the seedlings. The principle of the method lies in the protection (shelter) which the seed trees (nurse trees) afford the young growth during its youth. The number and severity of the cuttings and hence the duration of the entire removal period, depends upon the rate of establishment and the need of light by the young growth.

G., Schirmschlagbetrieb (Gayer and Lorey), in part Femelschlagbetrieb (Lorey). F., régime de la futaie regulière.

In theory the series of cuttings is divided into four parts as follows:

Preparatory cuttings or *fellings* fit the stand for its reproduction (regeneration) by the removal of dead, dying, or defective trees and undesirable species, and prepares the ground for the seedbed and encourages seed production. A stand in which one or more preparatory cuttings have been made is in the preparatory stage.

G., Vorbereitungschlag. F., coupe préparatoire.

Seed cutting or *felling.* A further opening of the stand, before seeding takes place, to secure the amount of light which the expected seedlings will require. A stand in which one or more seed cuttings have been made is in the seeding stage.

G., Besamungsschlag. F., coupe d'ensemencement.

Removal cuttings or *fellings* gradually remove the mature stand, which would otherwise retard the development of the young trees. A stand in which one or more removal cuttings have been made is in the removal stage.

G., Lichtschlag. F., coupe claire.

The *final cutting* or *felling* is the last of the removal cuttings, in which all of the old stand still remaining is cut. (G., Abtriebsschlag, Endhieb. F., coupe définitive.) In practice a two cut shelterwood method may be used, including the seed cutting and final cutting stages. The shelterwood method may be applied to a stand in narrow strips, from the leeward side, at such intervals that reproduction cuttings are generally going on in three strips at one time, one strip being in the removal stage, one in the seeding stage, and one in the preparatory stage. This manner of application is termed *Shelterwood strip method.*

Another modification of the shelterwood method of reproduction is that in

which groups of valuable advance growth, if present, form the starting points for the cutting which radiates from these centers. Such an application is termed *Shelterwood group method.*

6. *Coppice method.* A method of renewing the forest in which reproduction is secured by sprouts.

Syn.: sprout method.

G., Niederwaldbetrieb. F., régime du taillis simple.

7. *Coppice with standards.* A method of reproduction in which seedling trees or selected sprouts (standards) are maintained above a coppice or sprout forest. *See* Composite forest.

G., Mittelwaldbetrieb. F., régime du taillis.

Reproduction period. The space of time required or normally decided upon for the renewal of a stand by natural regeneration.

Syn.: regeneration period; return period.

Reserve. 1. A tree or group of trees left uncut on an area for a period, usually a second rotation, after the stand is reproduced naturally or artificially. It may also refer to whole stands held back from utilization. A tree reserved primarily in order to seed the felling area is termed a *seed tree. See* Reproduction, Seed tree method. A tree held over from harvest to grow into or through a second rotation, usually to secure increased diameter development, may be termed a *hold-over.* A tree reserved in coppice cutting is termed a *standard. See* Reproduction, Coppice with standards.

2. A tract of forest set aside for forest management.

Syn.: national forest.

Restock. *See* Reforest.

Revision of working plan. The rewriting of a working plan at the end of, or during the working period. Such renewals may be made at fixed intervals of, say, 10 years, or at irregular intervals, as is commonly the case where revised data or changes in prevailing market conditions, etc., necessitate modification of the original plan.

Ride. A term used in English literature for opened up division lines between compartments.

G., Schneisse, Gestell. F., laie.

Ripe. *See* Mature forest.

Root sucker. A sprout from a root.

Rotation. The predetermined time period during which it is intended to cut over a working group; the predetermined, *approximate* felling age of stands. Rotation refers to the *forest* as a whole and is expressed not by a definite year, but a period of 10 to 20 years; *felling age* refers to a stand and a definite year.

Rotations are determined either by technical, economic, or financial considerations; silvicultural considerations exercising a limiting influence.

Technical rotations attempt to produce the maximum amount of material suitable for a certain purpose, such as railroad ties, mine timbers, saw logs of given size.

Economic rotations attempt to secure either the maximum average volume production, or the maximum average value production.

Financial rotations introduce considerations of cost and attempt to secure either the maximum forest rent or maximum soil rent (*q. v.*).

Syn.: income rotation.

G., Umtrieb, Turnus. F., revolution.

Row planting. *See* Forest planting.

Sale value. *See* Value.

Salvage felling. (*New term.*) Removal of trees killed or injured in a forest by fire, insects, fungi, or other harmful agencies, with the purpose of utilizing merchantable material and preventing the spread of insects and disease. *See under* Intermediate fellings.

G., Totalitätshieb. F., coupe accidentelle.

Sample plot. A sample plot is an accurately measured area used for purposes of experimentation or of mensuration. Sample plots may be either *permanent* or *temporary*.

Sample tree. *See* Mean sample tree.

Sapling. *See* Tree class.

Scale, *n.* The contents of a log or logs as determined by measurement with a scale stick.

Scale, *v.* To determine the contents of a log by measurement with a scale stick.

Scale rule. *See* Scale stick.

Scale stick. A stick usually graduated to inches, showing for logs of different diameters and lengths the corresponding contents in board feet or other unit according to a given log rule (*see* Log rule.)

Screen. *See* Shade frame.

Scribe. A tool designed for carving symbols in wood or bark, commonly used to mark lines or corner posts.

Syn.: timber scribe, tree scribe.

Second growth. Forest growth which comes up naturally after cutting, fire, or other disturbing cause. In lumberman's parlance, the smaller trees left after lumbering or the available trees for a second logging. *See* Old growth.

Seedbed. **1.** In natural reproduction the soil or forest floor on which seed falls.

2. In nursery practice, a subdivision of a nursery for the raising of seedlings.

G., Saatbeet. F., couche de semis.

Seed board. *See* Forest planting.

Seed cutting or **felling.** *See* Reproduction (Shelterwood) method.

Seed drill. *See* Forest planting.

Seed forest. *See* High forest.

Seed horn. *See* Forest planting.

Seed spot. A prepared spot usually about a foot square in which tree seeds are to be planted.

Seed spot method. *See* Direct seeding.

Seed tree. Any tree which bears seed; specifically, a tree which is to provide the seed for natural reproduction.

Syn.: mother tree; nurse tree.

G., Mutterbaum, Samenbaum. F., portegraine, semencier.

Seed tree method. *See* Reproduction, method of.

Seed year. A year in which a given species bears seed abundantly.

G., Samenjahr. F., année de semence.

Seeding. *See* Direct seeding.

Seeding stage. *See* Shelterwood method.

Seedling. **1.** A tree grown from seed.
G., Kernwuchs. F., brin de semence.
2. In nursery practice, a tree which has not been transplanted in the nursery. *See* Planting stock.
3. In natural reproduction, a tree from seed which has not reached a height of 3 feet. *See* Tree class.
G., Sämling, Keimling. F., jeune brin.

Seedling forest. *See* High forest.

Seedling sprout. A sprout resulting from the cutting of a seedling or small sapling. This is differentiated from coppice sprout or shoot because of its subsequent behavior.

Selection forest. A forest through all parts of which many, or theoretically all age classes are represented.

Selection method. *See* Reproduction, method.

Selection thinning. *See* Intermediate cuttings.

Self pruning. *See* Pruning and Clear.

Self-sown seed. Seed sown by any agency other than man.

Set free, *v.* *See* Intermediate (liberation) cuttings.

Severance felling or **cutting.** *See under* Intermediate cuttings or felling.

Shade enduring. *See* Tolerant.

Shade frame. A frame for the partial shading of a seedbed. It consists of a cover of laths, brush, or cloth, arranged so that light can be admitted as desired and is frequently used in combination with a frame and cover provided with wire netting to keep out birds and rodents.

Shaft. *See* Stem.

Shelterbelt. *See* Windbreak.

Shelter growth. An advanced growth used to protect shade-demanding species. A new term to designate nurse trees collectively.

Shelterwood method. *See* Reproduction, method.

Shoot. *See* Tree class.

Silvical. Pertaining to silvics.

Silvics. **1.** A branch of ecology that treats of the life of trees in the forest; forest ecology.
2. The life history, requirements, and general characteristics of a forest tree from the point of view of silviculture.

Silvicultural characteristics. *See* Silvics (2).

Silviculture. The art of producing and tending a forest; the application of the knowledge of silvics in the treatment of a forest.
G., Waldbau, Holzzucht. F., Sylviculture.

Single tree method. (*Obs.*) *See* Reproduction (Selection) method.

Site. An area, considered as to its physical factors with reference to forest producing power; the combination of climatic and soil conditions of an area. *See* Site class.
Syn.: locality, physical type.
G., Standort. F., station.

Site class. A designation of the relative productive capacity or quality of different sites with reference to the species employed; the volume or the height produced at a given age being used as standard for classification. In Europe five classes,

in the United States often only three classes are differentiated, designated by Roman numerals, quality I representing the most productive site class.

Syn.: quality of site.

G., Bonität. F., qualité du sol.

Slit method. *See* Forest planting.

Slope. The gradient of the land surface. In forest description, the following terms are used to define the slope, each of which has its equivalent in percentages of the horizontal distance and in degrees:

Level	= 0– 5%	=	0– 3°
Gentle	= 5– 15%	=	3– 8°
Moderate	= 15– 30%	=	8–16°
Steep	= 30– 50%	=	16–26°
Very steep	= 50–100%	=	26–45°
Precipitous	= over 100%	=	over 45°

Snowbreak. The breaking of limbs of trees by snow.

G., Schneebruch. F., bris de neige.

Social. Said of species apt to form pure stands.

Syn.: gregarious.

Soil. In forest description, the origin, composition, depth and moisture of the forest soil are considered under soil. Its depth, to subsoil, rock or groundwater, is defined by the following terms, each of which has its equivalent in inches:

Very shallow	= less than 6 inches.
Shallow	= 6 to 12 inches.
Moderate	= 12 to 24 inches.
Deep	= 24 to 36 inches.
Very deep	= over 36 inches.

The moisture of the soil is defined by the following terms:

Wet. When water drips from a piece held in the hand without pressing.

Moist. When water drips from a piece pressed in the hand.

Fresh. When no water drips from a piece pressed in the hand, though it is unmistakably present.

Dry. When there is little or no trace of water.

Very dry. When the soil is parched. Such soils are usually caked and very hard, sand being an exception.

Soil rent. *See* Rent.

Soil rent value. Value based on soil rent.

Sour humus. *See* Humus.

Sowing. *See* Direct seeding.

Space number. The average distance between the trees in a stand divided by their average diameter; used to estimate volume of stand.

G., Abstandszahl.

Sprout. A tree which has grown from a stump or root. *See* Tree class.

Syn.: shoot, root sucker.

G., Stockausschlag. F., rejet de souche.

Sprout forest. *See* Coppice.

Sprout method. *See* Reproduction methods.

Stagheaded. A term applied to a tree dead at the top as a result of injury, disease, or deficient moisture and nutriment.

Stand. A general descriptive term referring to an aggregation of trees, standing on a limited area, of more or less uniformity of composition and condition, or of age.

G., Bestand. F., peuplement.

In mensuration, the amount of material on a given area; usually expressed in terms of *Stand per acre.*

Syn.: growing stock.

Stand quality. *See* Quality of stand.

Stand table. A tabular enumeration showing separately for each diameter class and species, the number of trees on a given unit of area, usually an average acre. The corresponding volume may or may not be given. If given, the table may be called *Stock table* (*q. v.*)

Standard. **1.** *See* Tree class (in reference to size classification).

2. A seedling or selected healthy sprout in a coppice forest left uncut to grow for more than one rotation. *See* Reserve.

Status records. An administrative term for records showing the ownership of lands. Complete status records will show in detail the chain of title for each parcel of land and also for all servitudes and easements attached to the land. In addition, they usually show the location and extent of all qualified or temporary alienations, such as unpatented mineral claims, leased areas, or lands otherwise specifically under permit or affected by outstanding contracts, as for the sale of timber, etc. Status records usually consist of sets of maps, often called "tract books" and of written or tabulated records supplemental to the map records.

Stem. The trunk of a tree. The stem may extend to the top of the tree, as in some conifers, or it may be lost in the ramification of the crown, as in most broadleaf trees. In tree description, the stem is described as long or short, straight or crooked, cylindrical or tapering, smooth or knotty, clear or rough, etc. The synonym *bole* may be suitably reserved when speaking from the standpoint of utilization, using *stem* or *shaft* from the standpoint of mensuration, *stem* or *trunk* for description merely.

Syn.: trunk, bole, shaft.

Stem analysis. The measurement of stated cross sections of a tree to determine its increment at different periods of its life. A stem analysis may be either *partial* or *complete* depending on whether the measurements include only a portion or all of the stem.

Stem class. *See* Tree class.

Stem density. *See* Stock density.

Stem form factor. *See* Form factor.

Stock, *n.* **1.** The stump of a coppice from which sprouts are expected.

2. A general term used to describe the character of the forest cover in composition or condition or supply of material (stumpage).

In organization, *growing stock*, the volume of material present, as basis of management; in finance, the value or capital represented in the stumpage of a stand or forest. *See* Normal stock. Undesirably used as synonym for Stand.

Stock density. Expressed by reference to number of trees or total basal area per acre, three grades being recognized: dense, medium, open.

G., Bestandesdichte. F., consistance.

Stock map. A map giving by symbols and numbers the composition of a stand or forest.

Stock table. *See* Stand table. A table enumerating the volume of a stand by tree classes.

Stock-taking. *See* Forest survey.

Stool shoot. A sprout from a stump.

Stoutwood. *See* Assortment.

Stratify. In nursery and planting practice, to preserve tree seeds by spreading them in layers alternating with layers of earth or sand.

Strip method. *See* Reproduction, clearcutting method and shelterwood method.

Strip selection method. *See* Reproduction (Selection) method.

Strip seeding method. *See* Direct seeding.

Strip survey. A partial survey; more precisely a process of estimating timber by measuring it on strips laid out over the area to be surveyed according to a systematic scheme (*see* Forest survey) and applying the measurements to the whole area in proportion.

Stub. That portion of the trunk left standing when a tree is accidentally broken off.

Stump. That portion of the trunk below the cut made in felling a tree.

G., Stock. F., souche.

Stump analysis. A partial stem analysis in which the only section used is the surface of the stump. *See* Stem analysis.

Stump height. The average distance between the juncture of the stem and roots (root collar) and the surface of a stump.

Stumpage. **1.** Amount of saleable material in a stand.

Syn.: stock.

2. Stumpage value, the value of timber as it stands—"on the stump." May include all wood or only certain classes.

3. Price paid for standing timber.

Subcompartment. *See* Subdivision.

Subdivision. A larger or smaller part of a forest property segregated with a view to making units for purposes of administration, protection, organization, management.

District. Generically, any administrative unit; specifically, an aggregate of administrative units or forests for control and inspection purposes.

Forest. An administrativê unit, as National forest, State forest, Municipal forest.

Ranger district or *Range.* Part of a forest, an executive unit under care of a ranger.

Patrol district or *Beat.* An executive unit for protective purposes, under a guard or patrol.

Compartment. An organization unit or small subdivision for purposes of orientation, administrative, and silvicultural operations.

G., Abteilung, Jagen (Prussia).

Lot. A small subdivision of a compartment, differing in composition, age, or character, requiring different treatment from the main body of the compartment; impermanent if due to accidental, permanent if due to site conditions.

Syn.: subcompartment.

G., Unterabteilung, Abteilung (Prussia).

Block. A major division of the working plan unit, intermediate in size between the working plan unit and a compartment. A block is usually based on topog-

raphy and comprises a main logging unit or group of logging units. A single block may contain many thousand acres.

Working plan unit. A forest area managed under one working plan. It may or may not coincide with the administrative unit.

G., Wirtschaftsganzes.

Working group. An organization or working plan unit, comprising an aggregate of compartments or stands to be managed under the same silvicultural system and rotation.

Syn.: working block; working circle; working figure; working section; management class.

G., Betriebsklasse. F., Serie d'exploitation.

Sublot. *See* Subdivision.

Suppressed, *a.* Having growth seriously retarded by shade, dying or so far injured that recovery is not probable. *See also* Crown class.

G., unterdrückt. F., dominé.

Sustained annual yield. *See* Sustained yield.

Sustained periodic yield. *See* Sustained yield.

Sustained yield. The yield or cut of timber from a forest which is managed in such a way as to permit the removal of an approximately equal volume of timber annually or periodically, equal to the increment.

Taper. The gradual diminution of diameter in the stem of a tree from base to top.

Taper table. A tabular statement of average diameter measurements of stems at specified heights above ground, recorded for trees of varying d. b. h. and height classes. Used for determining volumes and dimensions of products.

Thicket. A stand of saplings. *See* Development class.

G., Dickicht. F., fourre.

Thin, *v.* To make a thinning.

Thinning. *See* Intermediate cuttings.

Timber forest. *See* High forest.

Timberland. *See under* Forest.

Timber form factor. *See* Merchantable form factor.

Timber scribe. *See* Scribe.

Timberwood. *See* Assortment.

Tolerance. The capacity of a tree to endure shade.

Tolerant. Capable of enduring more or less heavy shade.

Syn.: shade-bearing, shade-enduring.

G., Schattenertragend. F., à tempérament délicat.

Transition period. The time used in bringing an unorganized forest into sustained yield management.

G., Uebergangszeitraum. F., période de transition.

Transplant, *v.* To transfer seedlings from the seedbed and set them in the ground in another part of the forest nursery.

G., verpflanzen, verschulen. F., transplanter.

Transplant, *n.* A seedling which has been transplanted one or more times in the nursery. *See* Planting stock.

G., Schulpflanze. F., plant repiqué, plant rigolée.

Transplant board. An implement used in setting seedlings in transplant rows or beds. The principle of the tool is a device which holds the trees in place in a notched board so that a number may be planted at a time.

Trap tree. A tree felled or girdled for the purpose of collecting injurious insects.

Tree analysis. *See* Stem analysis.

Tree class. All trees of approximately the same size. The following tree classes are distinguished:

Seedling. A tree, grown from seed, not yet 3 feet high.

Shoot. A sprout, not yet 3 feet high.

Small sapling. A tree from 3 to 10 feet high.

Large sapling. A tree 10 feet or over in height and less than 4 inches d. b. h.

Small pole. A tree from 4 to 8 inches d. b. h.

Large pole. A tree from 8 to 12 inches d. b. h.

Standard. A tree from 1 to 2 feet d. b. h.

Veteran. A tree over 2 feet d. b. h.

See also Development class.

Tree compass. An instrument for measuring diameter, consisting of a pair of dividers and a scale bar.

Tree form factor. *See* Form factor.

Tree scribe. *See* Scribe.

Tree tape. *See* Diameter tape.

Trench planting. *See* Forest planting.

Trench sowing. *See* Direct seeding.

Trunk. *See* Stem.

Turnus. *See* Rotation.

Two-storied forest. A stand in which two height or age classes of considerable difference, usually, are developed or are intended to be maintained, as upper story or overwood and lower story or underwood. The term is not applicable to forest under reproduction, in which the appearance of two stories is the temporary result of an incomplete process, but to those forests of which the two stories of growth are a permanent feature.

G., Zweihiebig. F., à double étage.

Underbrush. All large woody plants, which grow in a forest, but do not make trees.

Under-cut. In forest management the cutting of a quantity of timber less than the annual growth of the forest or the predetermined annual cut. *See also* Lumber manufacturing terms.

Undergrowth. A term used to include underbrush, seedlings, shoots, and small saplings.

Underplant. To set out young trees or sow seeds under an existing stand.

Under-stock. A growing stock less than the normal growing stock.

Underwood. *See* Composite forest.

Uneven-aged. Applied to a stand or forest in which considerable differences in age of trees occur, differences varying with the average age of stand or forest. *See* Even-aged; Selection forest.

G., ungleichalteriger Bestand. F., peuplement melé.

Unit of regulation. *See* Subdivision, Working unit.

Used length. The total length of stem usable in commercial operations.

Used volume. The volume of that portion of the tree usable in commercial operations.

Utilization value. *See* Value.

Valuation survey. The survey of an average area (valuation area) selected for detailed measurement and valuation. Often objectionably used for mensuration areas when no valuation is involved but only material is measured.

Value. The following values may be differentiated:

Investment value. The purchase price or the actual expenditures or investments that have been made in acquiring or creating the property with interest, less incomes actually derived from it, with interest.

G., Anlagekapitalwert.

Cost value. An investment value based on production. This may be differentiated into *Subjective cost value* if based on actual expenditures, and *Objective cost value* if based on estimated cost of replacement of the property (as in damage suits).

G., Kostenwert.

Sale or *Exchange value.* The market price based on statistics of actual sales; a special kind of sale value is the *forced sale* or *wrecking value* that can be obtained by exploitation of saleable parts (*see* Stumpage value.)

G., Verkaufswert. F., valeur vénale.

Stock or *Stumpage value.* Based on sale value of material ready for immediate utilization.

Syn.: utilization value.

G., Nutzungswert.

Expectancy value. The present worth of all estimated or expected future net earnings (discounted value); the capitalized net income value.

G., Erwartungswert. F., valeur d'attente.

Rent or *Yield value.* A value, determinded by capitalizing, with a demanded rate of interest, the yearly or intermittent net return possible to be derived from a managed property. *See* Forest rent and Soil rent.

G., Bodenrentierungswert; Waldrentierungswert.

Value increment. *See* Increment.

Veteran. *See* Tree class.

Virgin forest. Applies to mature or overmature forest grown entirely uninfluenced by human activity.

Syn.: old growth.

G., Urwald. F., forêt vierge.

Volume table. A tabular statement showing, for a given species, the average contents of trees of different sizes. The usual volume table is based on diameter and height. Volume tables may be made for any desired unit of volume.

Volunteer growth. *See* Advance growth.

Water sprout. An epicormic branch arising from a dormant or adventitious bud.

Weed tree. A tree of a species which has little or no value.

Weeding. *See* Intermediate cuttings, cleanings.

Windbreak. Any object which serves as an obstacle to surface winds; in forestry trees serve such a purpose. Tree windbreaks are classified according to their general arrangement.

1. Rows and hedge rows; **2.** belts or shelterbelts of three or more rows; **3.**

groves, or in the most extensive case, forests. They may be of natural or artificial origin.

Windfall. 1. A tree thrown by wind.

2. An area on which the trees have been thrown by wind.

Syn.: windbreak, blow-down.

G., Windbruch. F., volis.

Wind-firm. Able to withstand heavy wind.

G., sturmfest, windfest. F., resistant au vent.

Wind mantle. A screen of trees, commonly used to designate the dense border of a woodlot or forest which prevents penetration of wind into the interior.

G., Waldmantel.

Wolf tree. A tree occupying more space than its silvicultural value warrants, curtailing better neighbors. A term usually applied to broad-crowned, short-stemmed reserves.

Woodland. *See* Forest.

Woodlot. *See* Forest.

Working block. *See* Subdivision.

Working capital. *See* Capital.

Working circle. *See* Subdivision.

Working figure. *See* Subdivision.

Working period. The period of years during which the working plan is intended to apply.

Working plan. The plan or plans under which a given forest property is to be continuously managed. *Annual* or *Periodic plans* may be based on the general working plan and may refer to any specified class of work, as the annual cutting or felling, planting, protection, grazing, or administration and improvement plan. Such annual plans may be either mere schedules or may contain more or less detail, explanations, estimates of cost and results, as seems desirable.

Working plan control. The records of the progress of the work on the forest as outlined by the working plan. In European practice these records are kept by maps and books. The entries are made periodically or at the time of completing each of the various projects. This control operates as a check on the execution of the working plan.

Working section. *See* Subdivision.

Working unit. *See* Subdivision.

Yield. The timber or wood volume that is (actually) or can be (normally) produced by a stand of a given composition at a given age under given site conditions and treatment—the actual or normal product of the stand. *See* Normal. In finance, may be expressed as money yield.

The term *Yield* involves the idea of futurity, hence for a statement of actual material on hand the term *Stock* is preferable. For the expression *Regulation of yield*, the expression *Regulation of cut* or of *felling budget* is preferred.

Yield table. A tabular statement of periodic yields attainable at different ages (usually in 10-year periods) per unit of area (usually per acre).

Normal yield tables are constructed separately for given species on different sites (and sometimes different growth regions) under different treatment, and are used as standards with which to compare actual yields. The statements of a normal yield table are derived as an average from the best producing areas. If a

normal forest were not only an idea, but actually attainable, the normal yield table would represent its productivity and stock.

Empirical yield table is a statement of the actual volumes of given stands. They are of local value only. Since there is no "experience" involved, the term *Local yield table* would be preferable.

In finance, volumes may be translated into values and referred to as *money yield table*, *income table*, or *financial yield table*.

G., Wald=or Forstertrag; Materialertrag; Geldertrag. F., rendement.

NOTES AND COMMENTS

Site and Site Classes

Site may be defined as[1] "An area considered as to its physical factors with reference to forest producing power; the combination of climatic and edaphic conditions of an area. *G.*, Standort; *F.*, Station."

Quality of site may be determined from index stands which have been under forest management. Sites may be classified according to quality in terms of height of trees or yield of index stands.

In forest terminology, site class is defined as follows: A designation of the relative productive capacity or quality of different sites, with reference to the species employed; the volume or the height produced at a given age being used as a standard for classification. In Europe five classes, in the United States often only three classes are differentiated, designated by Roman Numerals, Quality I representing the most productive site class. *G.*, Bonität.

The beginner in forestry may find difficulty in understanding site classification because of failure to realize the correlation between site factors and the silvicultural characteristics of species. Only those species, well adapted to the site under consideration, should be compared in reference to production, and then only in developed stands. Another possible source of confusion arises in reference to the time it takes to develop a given crop. This question is one aside from site discussion on itself, although pertinent in choice of species. Toumey[2] under the topic of choice of species in planting says: "In the indirect assessment of the site factors, the quality of the site or yield capacity is ascertained for the species upon which the assessment is based. When we try to relate this to another species, it should be remembered that the climatic and soil conditions which result in a maximum yield for one species may not result in a maximum yield for another."

Nisbet[3] says in reference to assessment of the quality of soil: ". . . . a soil which might only be regarded as inferior so far as the cultivation of mixed crops of oak, maple, sycamore, larch, Douglas fir, and beech are concerned, might perhaps be considered a moderately good, or even a good soil, if considered with regard to woods in which pines, spruces, and firs were to be the ruling kinds of trees."

---

[1]List of terms prepared by the Sub-committee on Terms in Silvics, Silviculture, and Forest Description, Committee on Terminology, Society of American Foresters, 1916.

[2]Toumey, J. W., "Seeding and Planting," p. 43, 1916.

[3]Nisbet, John, "Studies in Forestry," 1894.

Roth[4] makes the statement: "The height of white pine in mixture with hemlock and hardwoods is entirely independent, each kind going its own gait and reaching its own normal limits, and so clearly expressing that a particular acre in Site I for pine and Site III or IV for maple or beech."

The last two statements taken by themselves may cloud the fundamental conception of site classification. The true site class is not indicated by the height or the yield of stands of a species which cannot fully utilize the physical factors of site. Under such conditions, a third quality stand might be developed on what is actually a first quality site. The conformity of stand quality to site quality is a measure of good forestry practice. As yet we have in this country almost no proper index stands under management as correct bases for determining site classes.

SAMUEL N. SPRING.

ITHACA, JANUARY, 1917.

Professor Recknagel called attention in the last issue of the Proceedings[5] to the apparent lack of the poorer sites in this country. I shall endeavor to give my interpretation of the site question as I find it in the Douglas fir region of western Washington and Oregon.

My yield tables for Douglas fir are based upon three sites for the reason that this species does not occur in sufficient quantities to form a type upon a poorer site than what I have called Quality III. This species occurs only rarely above about 3,000 to 3,500 feet elevation on the west slope of the Cascade Mountains or in the Olympics, and it is about at this altitudinal limit that my Site III is situated. At about this elevation and ranging upward to some 4,500 to 6,000 feet, depending on the latitude, are to be found Sites IV and V, which I presume would be comparable to Sites IV and V in the European countries. The species found here are quite different, however, from those in Sites I, II, and III, with the exception of western hemlock and amabilis fir; the former occurring in practically all of these sites and the latter in all except Site I. Therefore, if in place of Douglas fir, western hemlock had been the subject of a yield study, we should have tables for yield ranging over the five sites. This, I believe, explains the lack of the poorer sites in the yield tables for Douglas fir.

I wish also to state that in my estimation we have the equivalents of

[4]Roth, F., "Concerning Site," F. Q., XIV, 1, p. 3.
[5]Pro. Soc. Amer. Foresters, Vol. XI, No. 4, pp. 441-443.

Sites IV and V in the Pacific States, and it is only the limited range of Douglas fir and the lack of sufficient study of these other species that gives the impression that these poorer sites are lacking.

E. J. Hanzlik,
Forest Examiner.

Olympia, Wash.

Sandy Ridge Improvement Cutting.

The Sandy Ridge improvement cutting in the Mont Alto State forest was made during the summer of 1912. It may be classified as a grade C thinning, but it was actually a combined thinning, salvage, and liberation cutting. The cutting was very heavy locally on account of the large percentage of defective trees and worthless species. Many of the removed trees were fire-scarred at the base, and attacked by fungi, particularly saprophytic species. The subjoined data will show the condition of the stand before and after the cutting operation

	Before cutting (1912)	*After cutting* (1912)	1915
Number of trees per acre (3 inches and over.)	483	291	291
Sectional area per acre (sq. ft.)	102.08	67.32	73.78
Form height factor (cords)	.31	.32	.325
Total yield (cords)	31.6	21.5	24
Average diameter (inches)	6.25	6.75	7.25
Age (years)	36	36	39
Height (feet)	51.5	51.5	52.5

Before the cutting operation chestnut and rock oak comprised 48 and 24 per cent, respectively, of the number of trees. After the cutting they comprised 68 and 20 per cent, respectively.

Black gum, red maple, sassafras, scrub oak and shad bush were the principal worthless species that were removed to improve the composition of the stand. In addition, dead, suppressed, crooked, forked, stagheaded, decapitated, and diseased trees were removed.

The material obtained from the cutting operation consisted of cordwood, telephone poles, posts, bean poles, and pea brush. The cordwood (42.54 cords) was sold at an average price of $1.40 per cord in the woods.

The cutting was done by a class of students in charge of a skilled and regularly employed woodsman at an average cost of $1.25 per cord.

The brush was not piled but scattered broadcast, and has now practically all rotted. A dense undergrowth, consisting chiefly of tolerant species such as red maple and rock oak, appeared immediately after the cutting, and is helping to maintain and probably to improve the productive capacity of the soil.

Numerous "water sprouts" have appeared along the trunks of chestnut, rock oak, and scarlet oak. They are the result of excessive light and abundant food in the case of rock oak and scarlet oak, but in the case of chestnut, on which they are most abundant, the chestnut blight fungus is the causative agent.

At the time of the cutting (1912) the chestnut blight was present at only one spot near the northwest corner. All infected trees were cut out. At present (1915) chestnut blight is found over the entire area, being heaviest near the original infected spot. A strip survey of July 23, 1915, showed 61 sound, 97 dying, and 6 dead chestnut trees on an acre. In an unthinned stand, just north of the spot infected at the time of the cutting, are found 82 sound, 56 dying, and no dead trees. The percentage of dead and dying trees is lower in the unthinned than in the thinned stand, even though it is nearer the spot infected in 1912.

Recent increment borings show that trees attacked by the chestnut blight are now making a poor diameter growth, while the sound trees are making a slightly larger growth than before the cutting. The annual rings since the cutting have an average width of one-tenth of an inch.

All blighted material will be cut out during the coming winter.

J. S. Illick.

The distinctive feature of the development of timber sales in Montana and Idaho in recent months is the very pronounced demand for timber suitable for paper pulp. The establishment of one or more pulp mills operating on National Forest timber has been proposed, with capacities varying from 10 million to 50 million feet annually. None of these plants have yet materialized, but it seems very probable that one will materialize in the near future.

In fire protection the development seems to be along the line of more accurate classification of hazard and risk; risk being interpreted as the possibility or perhaps the liability of fires starting, while hazard is defined as the inflammability or combustibility of the forest cover. The effort to put fire protection upon a more scientific basis is resulting in the development of a distinctive and technical nomenclature.

The essential facts that may be gleamed from the report of Mr. H. S. Graves, Chief of the Forest Service, in his annual report are that an increase in receipts of more than $340,000 was secured over last year, totaling altogether over $2,800,000, of which from timber

alone over $1,400,000, a 20 per cent increase, while grazing receipts were $1,200,000, and water power rentals brought in $100,000. These receipts are approximately three-fourths of what it costs to protect the Forests and carry on the current business. In addition to this cost, however, there are expenses which are primarily in the nature of investments, such as roads and other improvements, reforestation of denuded lands, and classification and survey work. All expenses connected with the National Forests, including these investment expenses as well as the cost of operation, approximate $5,275,000.

A steady increase in the returns from the National Forests is expected by the Chief Forester.

A moderate annual increase for three years in the grazing fee is contemplated which, if put into operation, will eventually bring the grazing receipts to more than $2,000,000. During the last ten years the value of the forage to the stockmen has materially increased because of the improved methods of handling the stock which have been introduced. The present demand for grazing privileges on a majority of the National Forests far exceeds the carrying capacity, and the demand is on the increase.

Investigations by the Forest Products Laboratory, at Madison, Wisconsin, have resulted in the use of spent tanbark in the manufacture of asphalt shingles to the extent of 160 tons per week. The value of the bark has been thereby increased from 60 cents to $2.50 per ton.

There were cut from the National Forests, in the fiscal year 1916, 604,920,000 board feet of timber. Of this amount, 119,483,000 board feet was cut under free-use privilege by 42,055 individuals. In all, 10,840 sales of timber were made, of which 97 per cent were under $100 in value, indicating the extent to which the homesteader, rancher, miner, small millman, and others in need of a limited quantity of timber drew upon the Forests.

We are privileged to quote from a private letter of Dr. C. A. Schenck regarding forest conditions in the war zone and occupied territory, which seem somewhat at variance from other descriptions.

In Poland, the crown forests are "placed in charge of German foresters taken from their jobs at home. No timber or wood is being cut without being marked. Fire patrols are maintained during the hot season. Industries (sawmills, paper mills, tannic acid factories,

and naval stores) are being developed. Never have the woods been better handled than they are now.

"In Belgium, there are practically no forests, except the gorgeous stretch near Brussels. Those in the Ardennes are 'woodlands,' or in a few cases, parks. The rest is scrubby stuff, so notable in the sandy plains of Flanders. All that the Germans have done is to insist that the woods should not suffer from fires. There is no such thing as reckless cutting by the Germans. Where the woodlands have been laid low by the armies on both sides, it was done to build trenches, log houses, and to gain a free sight for guns. A few fine avenues of trees had to come down also; but not 3 per cent of the avenues were thus ruined. To speak of wholesale destruction of fine woodlands by reckless soldiers is in the case of Belgium impossible because there were none save the famous ones at Brussels which stand as beautiful today as they ever did."

In the occupied part of France, to each army corps there is said to be attached a committee on economic questions. "A forest officer of rank is a member of each committee; his helpers are forest rangers taken from the ranks. When a battalion wants wood for building or for fuel or for charcoal the ranger is sent to mark the trees to be cut. The woods are suffering less from the war than the men, the animals (including game), the fields, the buildings, and the human hearts."

Before the Dominions Royal Commission, which is seeking information regarding the resources of the British Dominions, Mr. Elwood Wilson made statements regarding the forest conditions of the Province of Quebec. Of the total timbered area north of the St. Lawrence River of 304,000 square miles, over 100,000 must be considered inaccessible and less than one-half of the total is accessible at the present time, the available material on this being less than 500 million cords.

The consumption has increased during the last seven years 290 per cent, but if it were to increase only at 10 per cent per annum, less than 60 years would see the end of these supplies. In the St. Maurice River Valley, for which exact statistics are available, the increase in consumption for the last five years was at the rate of 28 per cent per annum. With 10 per cent increase here the supplies would not last 50 years. The influence of increment is considered questionable in this direction. Further interesting details of this testimony are to be found in Canadian Forestry Journal for December, 1916.

Jack rabbits are responsible for a large amount of destruction of young conifer growth in the Rocky Mountains and Coast Range on both sides of the line. The United States Biological Survey, Department of Agriculture, is making strenuous efforts to reduce the pest by poisoning and hunting campaigns. The same agency has an appropriation of $125,000 for predatory animal control. The extermination of seed-eating rodents on reforested areas and the conservation of bird life under the Federal migratory-bird law also brings this bureau in close relation to forestry.

R. C. Hawley and S. J. Record report a new enemy to white pine, namely ants, which girdle young plants, apparently to get rid of the shade, especially in plantations. The phenomenon has been observed in Connecticut, Massachusetts, New Hampshire, New York, and Pennsylvania. The trouble makes itself apparent by the yellowing of the foliage, increasing until the tree dies and then the leaves turn brown. Other species are also attacked, Scotch pine, juniper, aspen, hickory, gray birch. As many as 40 trees of a group were killed in one case, the damage appearing in circular areas of 10 and up to 25 feet in diameter. Killing of the ants is, of course, the only remedy.

Brush disposal has been made an integral part of logging contracts on the 2,000,000 acres of Indian reserves in Ontario. In hardwood forests merely lopping and scattering is practised; in coniferous forests piling and burning immediately follow logging operations. To compensate for this expense the dues are reduced approximately 40 cents per thousand feet.

The National Lumber Manufacturers' Association publishes a pamphlet discussing the question how far the use of wood in construction accounts for fire losses in the United States. An elaborate graphic chart and table of statistics and arguments seem to show that the apparently greater fire loss of the United States compared with European fire losses is not due to wood construction but to difference in valuation. By proper use of the data, it is claimed, "the ratio of the number of fires to brick and stone construction was more than double the ratio in the frame construction."

An effective demonstration that goat meat is just as good eating as mutton was recently made by Supervisor Bigelow, of the Tahoe

National Forest, and Grazing Ranger Poore. These men arranged for a lamb feed at the Elks' Lodge in Nevada City, Cal., a grazer furnishing the "lamb." When the feed was over and the meat had been pronounced excellent by all present they were informed that they had eaten a young goat instead of a lamb. The occasion was then improved to point out that throughout the country large numbers of goats could be grazed on lands not utilized by other animals, provided the present prejudice against goat meat could be overcome. If this could be done nearly every sheepman could run a band of goats with his herd, which would graze ground not touched by the sheep, open up the brush patches where sheep and cattle do not enter, and in this way increase the production and lower the price of meat.

The following table, which appeared on page 467 of the Yale Alumni Weekly for January 19 (Vol. XXVI, No. 18) shows the high cost to the University of educating foresters as compared with training men for other professions. The figures are for Yale University as follows:

Graduate School: 346 students: $386 cost per student.
School of Religion: 106 students: $573 cost per student.
Medical School: 58 students: $2,000 cost per student.
Law School: 119 students: $428 cost per student.
Art School: 49 students: $550 cost per student.
Music School: 99 students: $375 cost per student.
Forestry School: 25 students: $1,200 cost per student.
Of this $1,200 only 10 per cent is covered by tuition and other fees.

REVIEWS

The Moisture Withholding Power of Soils

Soil moisture is one of the dominant factors governing all vegetation, and its importance lies not in the total amount of water which the soil contains, but in the amount which the plant can draw out of the soil. A heavy soil containing 20 per cent of moisture may afford the plant less water than a sandy soil containing only 5 per cent. All soils withhold certain amounts of water from the plant because the soil particles, after the water has been reduced to a certain point, tend to exert a force or "back-pull" against further withdrawals of water. This force is the key to the moisture relations between the plant and the soil. Therefore Shull's[1] recent investigations dealing with this force are of the utmost value to all whose work depends on a knowledge of the moisture relations of the soil.

Most of the researches in soil moisture have until recently been directed toward the fundamental relationships between the soil and its water, independently of plant growth. This is of course the logical procedure in getting a basis for further work. Naturally, therefore, most of the contributions to our knowledge of soil moisture have come from the fields of physics and chemistry.[2]

It was not until after the physicists and chemists had begun to discover some of the fundamental properties of soils that others could begin to unravel the relationships between the soil and plant growth. The physical and chemical properties of soils are by no means known yet; in fact, only the first steps have been taken, but enough is known to permit the botanist to begin his work. In this connection, it is interesting that the first great contribution to our knowledge of soil moisture in relation to vegetation, the wilting coefficient,[3] came from the researches of a physicist and a plant physiologist working together.

---

[1] Shull, Charles A. "Measurement of the Surface Forces in Soils." Botanical Gazette, 52: 1–31, 1916.

[2] For example:

Briggs, L. J. "The Mechanics of Soil Moisture." U. S. Dept. Agr., Div. of Soils, Bul. 10, 1907.

Briggs, L. J., and McLane, J. W. "The Moisture Equivalent of Soils." U. S. Dept. Agr., Bureau of Soils, Bul. 45, 1907.

Free, E. E. "Studies in Soil Physics." Plant World, 14: 29–39; 59–66; 110–119; 164–176; 186–190; 1911.

[3] Briggs, L. J., and Shantz, H. L. "The Wilting Coefficient for Different Plants and its Indirect Determination." U. S. Dept. Agr., Bureau of Plant Industry, Bul. 230, 1912.

Shull's object in the investigation here reviewed was to find a method of measuring the force with which the soil particles resist the withdrawal of moisture. Briggs and McLane[4] had shown that a saturated soil gives up its moisture readily until a state of equilibrium is established between the tension of the water films on the soil particles and an external pull of 1,000 times gravity. The point is known as the "moisture equivalent," and is for all practical purposes a physical constant for any given soil.[5] Heavy soils hold large percentages of water at the moisture equivalent; light soils hold small amounts. Below the moisture equivalent the water is held by the soil with increasing tenacity. This "back-pull" or water-holding power was known to be very great, and has been the subject of numerous researches. But its magnitude remained almost entirely a matter of conjecture until Shull's work appeared. His investigation is, as he says himself, "a first attempt to throw light on an unexplored region of soil physics."

Shull's method is simplicity itself. He measures the force with which seeds possessing semi-permeable seed coats absorb water at different moisture contents. Using seeds of *Xanthium pennsylvanicum* and solutions of sodium chloride, and lithium chloride, he determined the osmotic pressure of this water-absorbing force for different degrees of moisture between air-dry and slightly over 50 per cent on the basis of the air-dry weight of the seeds. The internal pull of the seeds in their air-dry condition he found to be nearly 1,000 atmospheres. The pull decreases rapidly as the moisture content of the seeds increases until about 27 per cent of moisture is reached, then drops more slowly to zero at approximately 52 per cent. Since these data are the basis of his measurements of the moisture-retaining forces of the soil, they are worth giving here (p. 112).

The next step is simply to pit the internal forces of the seed against the surface forces of the soil particles, instead of against osmotic pressure. When a soil of given moisture content and the Xanthium seeds in contact with this soil reach equilibrium, we know that both the soil and seeds are exerting the same force in holding their moisture. As soon as equilibrium is established between the seed and a soil of known moisture content, Shull determines the moisture content of the seed. Knowing the force exerted by Xanthium seeds at different moisture contents (see table), he knows the force with which the given soil at the given moisture content holds its water.

[4] See note 2, "The Moisture Equivalent of Soils."

[5] For a discussion of the moisture equivalent in relation to other physical properties of the soil, see Free, E. E., *loc. cit.*, pp. 164–176.

To meet the criticism that friction retards the movement of water in dry soils, and that consequently the seeds do not reach equilibrium with the total soil mass, but only with soil near them, Shull devised a rotating method which brings the seeds constantly into contact with fresh soil particles.

Moisture Intake of Xanthium Seeds in Osmotic Solutions; Temperature 23.5° C. Intake in Percentage of Air-dry Weight

Solutions Volume Molecular	*Intake in Percentage of Air-Dry Weight*	*Osmotic Pressure in Atmospheres*
H_2O	51.58	0.0
0.1 M–Na Cl	46.33	3.8
0.2 M–Na Cl	45.52	7.6
0.3 M–Na Cl	42.05	11.4
0.4 M–Na Cl	40.27	15.2
0.5 M–Na Cl	38.98	19.0
0.6 M–Na Cl	35.18	22.8
0.7 M–Na Cl	32.85	26.6
0.8 M–Na Cl	31.12	30.4
0.9 M–Na Cl	29.79	34.2
1.0 M–Na Cl	26.73	38.0
2.0 M–Na Cl	18.55	72.0
4.0 M–Na Cl	11.76	130.0
Sat. –Na Cl	6.35	375.0
Sat. –Li Cl	−0.29	965.0

The principal sources of error, Shull states, are due to the impossibility of handling seeds in ordinary atmospheres without some loss by evaporation, and to the lower accuracy of hot-air ovens for drying as compared with vacuum driers. But every precaution was taken to reduce errors to a minimum, and Shull confidently believes that more refined methods would in no way change the nature of the conclusions drawn from the results.

The tests were confined to the region of soil moisture between air-dry and the wilting coefficient because in soil with a higher moisture content the seeds always became saturated. This alone is striking evidence of the significance of the wilting coefficient.

Most of the work was done with two soils, Oswego silt loam, a heavy soil with a moisture equivalent of 35.2 per cent and a wilting coefficient of 19.1 per cent, and a fine quartz sand with a moisture equivalent of 2.41 per cent and a wilting coefficient of 1.3 per cent.

For the Oswego silt loam he gives the results of 4 series of tests running from air-dry to approximately 20 per cent.

Exact comparison between the series is rendered a little difficult by the lack of regularity in the percentages of soil moisture. For

example, the moisture content of the soil varies from 4.65 per cent of absolute weight in series 4, to 6.66 per cent in series 1, and each series has different percentages of soil moisture. At no point is the exact wilting coefficient, 19.1 per cent given. This difficulty is, however, of minor importance, and is unavoidable; for in moistening a soil it is impossible to bring the moisture content to the exact point desired. The inconvenience in using the figures can readily be overcome by smoothing off the values with a curve. Of more interest is the degree of correspondence between the values for the intake of water by the seeds at the same moisture content of the soil. As might be expected, the values do not exactly correspond. For example, in series 1, a soil moisture of 19.80 per cent shows an intake by the seeds of 46.54 per cent of their air-dry weight, while in series 2, with a slightly lower soil moisture, 19.34, the seeds take in 49.31 per cent of their air-dry weight. This divergence does not, however, affect the validity of the conclusions.

The tests prove beyond dispute that the intake of water by Xanthium seeds is approximately uniform for a given moisture content in a given soil. Since the internal force of Xanthium seeds can be determined at practically any moisture content, this means that the water-absorbing power of Xanthium seeds can be used as a measure of the force exerted by soil of any moisture content in withholding water from the roots of the plant.

The results for the sand are just as interesting and striking as the results for the heavy soil. Shull found from preliminary tests that this sand had no "back-pull" until the moisture fell below 2 per cent. This was to be expected since the moisture equivalent was 2.41 per cent, and the wilting coefficient 1.3 per cent. The range between air-dry and the wilting coefficient was therefore restricted to less than one-tenth of the range for the heavier soil. This necessitated the use of very much finer divisions in the soil moisture content. For example, a difference of only .016 per cent of soil moisture makes a difference of 3.5 per cent in the water intake of the Xanthium seeds, and a difference of only .237 per cent of moisture in the soil makes a difference of 12.17 per cent in the seed. This must have made the experimentation more difficult. It shows strikingly the difference which extremely small amounts of moisture make in the water-withholding force of light soils below the wilting coefficient. The "back-pull" of a light soil between its air-dry condition and its wilting coefficient covers the same range of force as that exerted by a heavy soil, only

in the light soil a very much smaller difference in moisture content is required for a given difference in force.

One of the most interesting parts of the paper is the comparison between the wilting coefficient and moisture intake by Xanthium seeds for nine different soils. These soils ranged from coarse sand with a wilting coefficient of only .73 to clay loam with a wilting coefficient of 16.34. Except for discrepancies in the case of the coarse sands, the results are remarkably uniform. The average intake, excluding the two coarse sands, is approximately 49 per cent, which agrees with the intake from the Oswego silt loam and the fine sand at their wilting coefficients. "This probably means," says Shull, "that the wilting coefficient represents a fairly definite water-holding power for the soil particle, regardless of its size." Comparing the results for all the soils with the osmotic pressure in atmospheres for Xanthium seeds (see table quoted above), it is found that the "back-pull" of the soil, or the force with which it withholds water from seeds and plant roots, at the wilting coefficient is from 3 to 4 atmospheres. This Shull considers surprisingly low.

In addition to the Xanthium seeds, Shull has tried to use seeds which do not have semi-permeable seed coats. Since osmotic solutions are useless for these seeds, he used a vapor pressure method, which consists essentially in measuring the vapor pressure equilibrium of air-dry seeds suspended over sulphuric acid of varying strength, and calculating the internal pressure of the seed from the vapor pressure of the solution over which it is found to be in equilibrium. The calculations are near enough to the osmotic determinations to be of considerable interest. But, owing to the insufficiency of our knowledge of concentrated solutions and of the exact relations of colloids to water vapor, these calculations give only a rough estimate of the internal forces of the seeds and consequently were not used in measuring the water-holding power of the soil.

This piece of research has shown that the force with which the soil holds water at the moisture equivalent is equal to about 1 atmosphere. The force at the wilting coefficient is from 3 to 4 atmospheres, and when the water is reduced below the wilting coefficient this force increases rapidly until at the air-dry condition it is about 1,000 atmospheres.

The next step is to discover the relations between the roots of the plant and the soil moisture. Shull's work throws more light on this problem than any investigation since Briggs' and Shantz's publica-

tion in the wilting coefficient, but some of his conclusions are open to question. Following Hannig[6] he had taken the average osmotic pressure of the root cell sap to be equivalent to from 7 to 8 atmospheres. Since the water-holding power of the soil at the wilting coefficient is only 3 to 4 atmospheres, and furthermore since seeds in soil at the wilting coefficient take up within a few per cent of as much moisture as they do when placed in water, he concludes that wilting at the wilting coefficient is not due to lack of moisture. The cause of wilting, he says, is that the rate of movement of water in the soil becomes too slow to meet the needs of the plant. This, he continues, explains why Briggs and Shantz, working under uniform conditions of evaporation, found the same wilting coefficient for all kinds of plants in a given soil, regardless of root sap concentration and other variable factors. It also explains, he adds, why with high evaporation wilting occurs before the water has been reduced to the wilting coefficient as in the work of Caldwell[7] and of Livingston and Shive[8]; it is because the whole matter is a "question of rates."

Here Shull has been influenced by a misconception which Caldwell and Livingston have introduced into the application of the wilting coefficient. Caldwell found that when plants which have been grown under conditions of moderate, or even fairly high, evaporation are placed under conditions of intense evaporation they wilt before reducing the water to the wilting coefficient.[9] His results gave rise to the idea that the wilting coefficient is dependent on the rate of evaporation; and Livingston and Shive went so far as to plot a curve of the relation between evaporation and the wilting coefficient, showing that the water left in the soil at permanent wilting increases with the rate of evaporation.

Briggs and Shantz show, on page 62 of Bulletin 230, that field

---

[6] Hannig, E. "Untersuchungen über die Verteilung des osmotischen Drucks in der Pflanze in Hinsicht auf die Wasserleitung." Ber. Deutschc. Bot. Gesells, 30: 194–204, 1912.

[7] Caldwell, J. S. "The Relation of Environmental Conditions to the Phenomenon of Permanent Wilting in Plants." Physiological Researches, Vol. I, No. 1, 1–56, Baltimore, Md., 1916.

[8] Shive, J. W., and Livingston, B. E. "The Relation of Atmospheric Evaporating Power to Soil Moisture Content at Permanent Wilting in Plants." Plant World, 17: 81–121, 1914.

[9] Caldwell does not say much about the conditions under which his plants were grown before making the wilting tests, but it appears that some were grown in the open. If this open had the same evaporation and insolation as that of the wilting tests, the explanation which the reviewer gives below does not hold for all of Caldwell's work. It seems probable, however, that in most cases the wilting tests in the open were made under conditions more severe than those under which the plants had been grown.

crops growing under the high rates of evaporation prevalent at the western edge of the Great Plains reduce the soil water to the wilting coefficient before they wilt. Furthermore, Burr[10] has shown, in charts VII and X–XV, that under natural conditions in western Nebraska, where the evaporation rate is high, field crops reduce the soil water to the wilting coefficient during their period of growth before permanent wilting takes place.

The explanation of the apparent discrepancy between the point of view of Briggs and Shantz and of Caldwell is probably to be found in Caldwell's failure to distinguish between the effects of high evaporation and the effects of *sudden changes* in evaporation. When a plant is moved from moderately sheltered surroundings into the full sunlight, it wilts, regardless of the moisture in the soil. Wilting in this case is due to the change of environment rather than to the severity of the last environment.

The wilting of plants which are suddenly moved into an environment characterized by high transpiration is not entirely due to slowness of water movement through the soil, as Shull implies, but largely to the inability of the root system to supply the sudden increase demanded by the increased transpiration. This is shown by the fact that a plant can be made to wilt in a water culture by a sudden change in the conditions governing transpiration. In this case wilting is obviously not a question of the rate of water movement outside of the plant.

This does not, however, explain why plants wilt when their roots can still exert a pull 3 or 4 atmospheres greater than the "back-pull" of the soil. The reason for this, Shantz is inclined to believe,[11] is that the wilting coefficient determination is more a matter of soil physics than of a balance between the "back-pull" of the soil and the pull of the plant. He is "still not entirely sure that the wilting coefficient determination represents anything more (nor less, we might add) than a point in the water-content of the soil at which the water practically ceases to move along the film (on the soil particle), no matter how sharp the gradient at the edge of this film." An indication that this may be the case is found in the fact that seeds placed in soil which has been reduced to the wilting coefficient cannot absorb any great amount of water; but when the soil is tumbled over them (as in Shull's experiments) the seeds absorb as much as in a very

[10] Burr, W. W. "The Storage and Use of Soil Moisture." Research Bul. No. 5, Agr. Expt. Sta. of Nebraska, 1914.
[11] Shantz, in a letter to the reviewer.

humid soil or in water. Furthermore, Shantz has found that the minimum moisture content at which seeds will germinate is somewhat above the wilting coefficient.

Shantz's explanation not only removes the difficulty, but throws a flood of light on the wilting coefficient.

BARRINGTON MOORE.

NEW YORK, N. Y., *December*, 1916.

THE ORGANIZATION OF THE LUMBER INDUSTRY[1]

Early in the year 1916 a book was put out from the press of the American Lumberman, written by a late graduate in economics, like which there is nothing else in the field, and which a wide circle of persons would do well to examine. Considering the circumstances in which it was produced, it is a marvel of achievement. It contains a vast fund of information; it presents a balanced view, ethically speaking, of the lumber industry, and it develops much that has been poorly understood in the economics of that industry. On the other side, those identified with conservation will gain an insight and direction from this review of affairs by a man who is cool and an economist. This review can attempt no more and nothing better than to create a desire for perusal of the book itself.

No publication comes to mind in which so many significant facts relating to timber and the lumber industry are brought into so small a compass. The second chapter, for instance, on organization for production, brings together the census figures on production from 1850 to date, does the same for sawmills, their number, capacity, and capitalization, and traces the history of production by regions, adding to this some pages, natural for an economist but to date untouched by writers except those of the industry itself, on the gain in economy of the modern mill. Chapter four, similarly, following a summary of the statistics on the timber resources of the country, along with much else, gives an insight into the degree to which timber ownership is now concentrated, and presents a body of figures sufficient for general information on stumpage prices, as they have been in the past and are today.

To bring this and other such information together in convenient

---

[1]Wilson Compton. American Lumberman, Chicago, 1916. Pp. 153.

for the author, however, who connects it all into a logical fabric em- form would have been worth alone a book. It is only a starting point bracing the most timely and important problems and tendencies in the whole field.

It was said at the start that conservationists should profit from the ideas of a cool man and an economist. Merely following the aspects of the industry developed in that way helps to that purpose, opening up its complexity, difficulties, what competition means. Then Compton emphasizes a side of the matter which foresters, in their intentness on increased production, have neglected occasionally—the value of our native stock as the basis of industry and a reserve of high class material. But the big feature of the work as respects both this and its other bearings is his development of the relations of price. Under his handling that appears as the crucial point of the whole matter. Quantity and quality granted, the desire or necessity of the people is expressed in price. The whole history of the lumber industry stands as a response to that, and the developments of the future, along however different lines they may lie, will be enjoyed in the same way.

Here Compton touches conservationists very closely. He is sympathetic but conservative. Broad changes in economic demand are familiar to him and he sees a vast range of forces playing upon that factor and on price. A "habit of inordinate consumption" of lumber is a striking phrase which seems to embody his idea on one branch of the subject. Then this view takes in the timber resources of as yet undeveloped countries and the substitution of other materials for lumber. He does not, however, directly and at length, develop this subject.

It is the lumber industry itself, however, that will gain most from his work. Familiar as it is or might be, it has been poorly understood by many makers of public opinion, and under suspicion and disfavor in the recent past. As a corrective, putting this industry on the level with others, where it belongs, this book should be effective in whatever area it can cover. It is, in fact, astonishing to consider how convincing the work of a single, earnest, competent and balanced man can be as against the results of enormous expenditure through a big organization.

A very few lines in the way of review must suffice for the present purpose. The lumber trust bogy is put to rout through a picture of the dispersal of the industry, the regional competition within it, and especially through a broad study of the history of lumber prices. In

this field, Compton sums up the significant facts and factors of recent times about as follows:

(*a*) A rise in lumber price started about 1880, general, but induced primarily by the exhaustion of the best and handiest Lake States timber.

(*b*) A decline in price followed for a number of years ending with 1897, parallel with the course of general prices.

(*c*) A rise in prices from 1897 to 1907 stronger than that for commodities at large.

(*d*) Moderate increases in price, involving, however, a slight *relative* loss, from 1907 to 1913.

Beneath all these phenomena are general causes common to all industries and showing in general prices, as Compton explains. Local exhaustion of timber supplies, separating producing from consuming centers, and adding cost in the way of freight accounts mainly for the rest. The fact noted under (*d*) above is largely explained by substitution. There are also educational and psychological factors. While not denying that cooperation among lumbermen has at times had some effect on prices, Compton concludes in a broad way that "Natural influences furnish adequate explanation of lumber prices." This conclusion is fortified by study of the history of prices in Europe and in Canada.

In the field of stumpage, conclusions of a generally similar nature are likewise drawn, as indicated by the following: "Concentration (of ownership) does not imply higher prices," although it constitutes a "situation which promises in the future to become a serious challenge to public policy." "Principle of competitive timber price fixation"; "the charge of speculative holding of standing timber therefore is simply the admission of an inevitable economic fact."

This book is professedly an economic one strictly. As such it seems to be both adequate and fair. The author gives the impression that he would have no quarrel with the man who sees things from a somewhat different angle and lays more weight on other points, if there were equal disposition to give just weight to economic considerations where they apply.

AUSTIN CARY.

A Glimpse of the Siberian Forests.[1]

In 1913, Fridtjof Nansen made an interesting journey by boat through the polar seas to the mouth of the Yenisei River, up this great waterway as far as Krasno-Yarsk; thence northwesterly beyond Tomsk and easterly via the Trans-Siberian Railway to Vladivostok. As a result of this trip he tells of the great future for the development of the rich Siberian agricultural soils—such as is rapidly taking place in northern Canada. In the account of his journeys he gives enough brief references to the forest wealth (or poverty) of the country to excite the desire for more data and data of an exact character. What an opportunity for some Russian to describe "The Forest Resources of Siberia."

At the mouth of the Yenisei, Nansen noted a "lighter . . . filled with great beams of Siberian cedar, deal and pine"—presumably for export to Europe! Here on Nosonovski Island (roughly 75° north latitude and 80° east longitude) he speaks of stretches of "osier scrub . . . as high as one's chest . . . also some alder."

The first real tree growth on the Yenisei was at latitude 69° 43′, near Khetnisky Island, opposite Krestova. "They were small larches (*Larix siberica.*) There were not many of them. They were scattered over the ground and looked more like bushes than anything else." Two and a half degrees further south Nansen describes forests of "larches and firs (*Abies siberica*) and the Siberian cedar (*Pinus cembra*) which is also beginning . . . (but) chiefly yellow birch, with some alders and osiers among it, and scattered splashes of red mountain ash. The coniferous forest has been destroyed by fire over and over again in course of time along this river"—owing to careless camp fires which "nobody takes any notice of. . . . The forest has no value. So it has gone on from time immemorial." Perhaps the most interesting reference to these northern forests is the following:

"Another curious thing is that all this forest is so thin . . . all these trees here grow on frozen soil. On the top there is a shallow layer which thaws in the summer, but underneath the soil is eternally frozen. . . . The roots of the trees cannot, therefore, strike down, and must grow horizontally along the ground near the surface. Even the fir[2] cannot strike its tap-roots downwards here, as it would immediately come upon frozen soil and ice. It will, therefore, be understood that these trees must have more room for their roots. . . ." Thus Nansen accounts for wide spacing by root competition in the unfrozen surface soil, instead

[1] Fridtjof Nansen. (Translated by Arthur G. Chater.)
"Through Siberia: The Land of the Future." Frederick A. Stokes Co. New York, 1914. P. 477.

[2] Nansen is evidently not a trained forester. T. S. W., Jr.

of by the commonly accepted explanation that extreme cold affects tree spacing as does extreme aridity.

It is such a pity that Nansen's references to forests are so unscientific. At 66½° north latitude he speaks of "also larch and a luxuriant green tree very like a fir, with long needles, like those of the New Jersey scrub pine. This was the so-called Siberian cedar, which is really a sort of fir (*Pinus cembra*). This seems to be valuable largely because of its edible nuts ("Russian nuts").

As he worked his way farther south the forest destruction from fires appeared more disastrous; "signs of forest fires were to be seen on every hand. . . . In spring and early summer it is very dry here, so that a forest fire easily spreads; when once it begins, it may burn for weeks in these parts." Again he refers to destruction by fires: "Time after time we passed forest fires, the smoke of which extended for great distances . . . it is constantly being burnt. The grass in the valleys is burnt off twice a year, in autumn or spring, so that the withered grass may not check the growth of the fresh, green grass in spring." In past decades such methods were not unheard of in the Western United States.

One cannot read this interesting narrative without wishing that Nansen had been more scientific in his numerous references to forest growth. What a pity these northern forests are being destroyed!

THEODORE S. WOOLSEY, JR.

NEW HAVEN, CONN.

REFORESTING METHODS AND RESULTS OF FOREST PLANTING IN NEW YORK STATE.[1]

This account is based on thirty-five typical private plantations in nine localities within the State, leaving the 7,000 acres of State plantations out of consideration. There seem to be over 20,000 acres of private plantings in the State.

It is notable that out of the six coniferous species recommended for planting half the number are European species: Norway spruce, Scotch pine, and European larch.

The financier was evidently not present when the sentence was written: "For extensive planting on sites of varying character, 3 and 4 year-old transplanted stock should always be used." We doubt whether the use of such plant material justifies the later statement regarding cost, that "the average cost should not exceed $6 under favorable conditions."

[1] By B. H. Paul. Bulletin 374. Cornell University, College of Agriculture. Ithaca, N. Y. 1916. Pp. 649–92.

The results of different planting methods leave us in doubt which to use except that the mattock-slit method without removal of sod is not to be recommended.

The now much contested theory of tolerance receives confirmatory evidence. While we hold tenaciously to the importance of light relations—we had not expected that the shade "afforded by grass and weeds during the first two years," especially during *dry weather*, could be made beneficial! We are inclined to think that another reason for the results of the removal of grass and weeds must be found, than that "the high percentage of loss was caused by sudden exposure of the young trees to hot sunshine when the protection that had been given them by the grass was taken away."

In a table the conditions of the various plantations are clearly stated. When the percentage of living plants in thirteen years is still 60 and 65 per cent and for those of younger age lies mostly above 80 and up to 95 per cent, we can say that all plantations (coniferous) have prospered unusually well. The white pine weevil and the unfortunate blister rust have, however, damaged the white pine in various plantations.

For the discussion of yields two older sets of plantations, from 15 to 44 years old, were available. The oldest series of plantings at White Lake Corners by the late Mr. T. Dallarme was begun in 1870 with white pine, European larch, Scotch pine, and sugar maple. Other of his plantings were 31, 35, and 40 years old, all on Adirondack stony loam, site I.

The oldest plantations were calculated to have produced over 38,000 feet board measure with 408 trees per plot, the 31-year-old stand producing 18,440 board feet with 760 trees. Other plantings indicate a product of around 7,000 cubic feet in 40 years, which is better than any production usual in Germany.

B. E. F.

Protection of Life and Property Against Lightning[1]

Although the object of this publication is "to present the information at present available on the subject of protection against lightning, with a view to bringing about a greater uniformity of practice in the installation of lightning rods, and encouraging people to make use of

[1] By O. S. Peters, Assistant Physicist. Technologic Papers of the Bureau of Standards, No. 56. U. S. Department of Commerce. Washington, D. C. 1915. Pp. 127.

them as a protective device," still it contains much of interest and value to the forester, for lightning and its results are to be taken seriously by him.

Numerous tables are given showing the total number of fires caused by lightning (forest fires evidently not included) by States, analysis of fires by causes, statement of deaths by lightning, etc., obtained from State fire marshals and insurance companies. During 1910 the total fire loss in the United States is given as approximately $250,000,000; of this 3.31 per cent, or about $8,500,000, may be attributed to fires caused by lightning. The author does not state whether this heavy fire loss in 1910 included the loss of timber and other property caused by the disastrous forest fires of that year or not; in fact, nowhere in the entire bulletin is there mention of forest fires or lightning in its relation to forest fires, in any way!

As regards the loss of human life from lightning the author estimates, from fairly accurate statistics, that for the years immediately preceding and following 1910 "during the course of a year 1,500 or more persons" are affected by lightning stroke in the United States, of which number about one-third are killed. Census data shows that more than nine-tenths of the fatalities due to lightning occur in rural districts.

Considerable space is given to a discussion of lightning rods, historically and scientifically, the form, structure, materials, manufacture, etc., with the conclusion that a lightning rod is a good thing, and that a poor lightning rod on a building is better than no rod at all. From available data lightning rods reduce the fire hazard from lightning by 80 to 90 per cent in the case of houses and as much as 99 per cent in the case of barns.

Fire hazards from lightning in barns and houses is discussed, with the conclusion that a person is safer from lightning in a house than in a barn, also that far more barns than houses are destroyed by lightning, which is logical, due to the relative difference in inflammability. Statistics are given showing that of 200 barns struck 87.5 per cent were fired, while of 325 houses struck only 23 per cent were fired. The chances for the occupants of a lightning-struck house escaping injury is given as 45 out of each 100. Considerable space is devoted to methods of safeguarding human life and livestock in fields from lightning.

The publication has a complete summary of thirty-one conclusions, among which the author finds that during lightning storms houses are safer than barns or isolated buildings, that under thick timber is safer

than under a single tree in the open, or an open shed, that inside a building the unsafe places are near screen doors, telephones, chimneys, stoves, and places between masses of metals on the outside of buildings. Out of doors the most dangerous places are in open fields, under isolated trees and near wire fences, and the safest is in thick timber.

The appendices contain rules for installing lightning rods as specified by insurance companies, or by law, in the United States, Germany, and England, very practical directions for first aid to persons injured by lightning, as well as rules for putting out fires (in buildings), rescue, etc., which will be of very practical value to the foresters. A bibliography of forty publications of American and European authorship is added, which, the author states, is by no means complete.

J. D. G.

Handbook for Rangers and Woodsmen [1]

Forestry students and recent graduates who go into forest work in the West have long felt the need of a handy pocket-size manual which dealt with the many problems that the newcomer meets in that region. Taylor's book, which admirably supplies these data, is the first handbook of its kind which has been written in this country especially for forest workers.

The author states in his preface that the book has been prepared as a guide for men inexperienced in woods work. Although written largely from the standpoint of the man who enters National Forest work, yet there is much of great value to those engaged in practical forest work in every region.

The chief subjects treated are: Equipment, Construction Work, General Field Work, Live Stock, and Miscellaneous Appendix.

An especially valuable part of the manual is that portion dealing with live stock and its care, since, so far as is known, this information has never been previously treated in concise form from the forester's standpoint, by an expert.

This handbook is welcomed as a most valuable addition to our forest literature, since it is believed that it will be of inestimable value to both those who are just starting in the profession and to the older men who want a reference work on the various practical subjects covered.

R. C. B.

---

[1] Jay L. B. Taylor. John Wiley & Sons, Inc. New York. 1917. Pp. 420. Illustrated.

RECENT PUBLICATIONS

Some Public and Economic Aspects of the Lumber Industry. Studies of the Lumber Industry, Part I. By W. B. Greeley. U. S. Department of Agriculture, Forest Service, Report No. 114. Washington, 1917. Pp. 100. Diagrams.

The Sierra Ranger. Volume VI, No. 3. Sierra National Forest, Northfork, Cal. November 1, 1916. Pp. 17.

State Forestry Laws. A parallel classification showing the comparative progress of each State in forestry legislation. U. S. Department of Agriculture, Forest Service.

Connecticut (regular session, 1915). Misc. S. 21. December 15, 1916. Pp. 12.

Ohio (regular session, 1915). Misc. S. 20. December 15, 1916. Pp. 4.

Report of Chief of Bureau of Biological Survey for Year Ended June 30, 1916. By H. W. Henshaw. U. S. Department of Agriculture. Washington, D. C. 1916. Pp. 16.

Management of Muck-Land Farms in Northern Indiana and Southern Michigan. By H. R. Smalley. Farmers' Bulletin 761, U. S. Department of Agriculture. Contribution from the Office of Farm Management. Washington, D. C. 1916. Pp. 26.

"White Ants" as Pests in the United States and Methods of Preventing Their Damage. By T. E. Snyder. Farmers' Bulletin 759, U. S. Department of Agriculture. Contribution from the Bureau of Entomology. Washington, D. C. 1916. Pp. 20.

Larkspur Poisoning of Live Stock. By C. Dwight March and A. B. Clawson. U. S. Department of Agriculture. Bulletin 356. Washington. 1916. Pp. 90. Plates.

The New Mexico Range Caterpillar and Its Control. By V. L. Tildermuth and D. J. Caffey. U. S. Department of Agriculture. Bulletin 443.

How to Attract Birds in Northeastern United States. By W. L. McAtee. U. S. Department of Agriculture. Farmers' Bulletin 621. Washington. 1915. Pp. 15.

Common Birds of Southeastern United States in Relation to Agriculture. By F. E. L. Beal, W. L. McAtee, and E. R. Kalmbach. U. S. Department of Agriculture. Farmers' Bulletin 755. Washington. 1916. Pp. 39.

White Ants as Pests in the United States and Methods of Preventing Their Damage. By T. E. Snyder. U. S. Department of Agriculture. Farmers' Bulletin 759. Washington. 1916. Pp. 20.

Hypoderma Deformans, An Undescribed Needle Fungus of Western Yellow Pine. By James R. Weir. Reprint from Journal of Agriculture Research. May 22, 1916. Pp. 277–88. Plates 32.

The Cottonwood Borer. By O. B. Milliken. U. S. Department of Agriculture. Bulletin No. 424. Washington. November 9, 1916. Pp. 8. Illustrated.

A description of the insect and methods of control.

Water Penetration in the Gumbo Soils of the Belle Fourche Reclamation Project. By O. R. Mathews. U. S. Department of Agriculture. Bulletin 447. Washington. November 22, 1916. Pp. 12. Illustrated.

Hemp Hurds as Paper-Making Material. By L. H. Dewey and J. L. Merrill. U. S. Department of Agriculture. Bulletin 404. Washington. October 14, 1916. Pp. 26. Illustrated.

The Flow of Water in Wood-Stave Pipe. By F. C. Scohey. U. S. Department of Agriculture. Bulletin 376. Washington. November 25, 1916. Pp. 96. Illustrated.

A publication for use of engineers designing and measuring wood-stave pipes for irrigation, power, municipal, mining, or other purposes and for courts and attorneys at law interested in cases involving the carrying capacities of wood-stave pipes.

Farming on the Cut-Over Lands of Michigan, Wisconsin, and Minnesota. By J. C. McDowell and W. B. Walker. U. S. Department of Agriculture. Bulletin 425. Washington. October 24, 1916. Pp. 24. Illustrated.

A popular discussion of the essential problems of the region.

A Review of the Fossil Plants in the United States National Museum from the Florissant Lake Beds at Florissant, Colo., with Descriptions of New Species and List of Type-Specimens. By F. H. Knowlton. Reprint from Proceedings of the U. S. National Museum, Vol. 51, pp. 241–97. Washington, D. C. November 24, 1916.

Two New Fossil Plants from the Triassic of Pennsylvania. By E. T. Wherry. Reprint from the Proceedings of the U. S. National Museum, Vol. 51, pp. 327–9. Washington, D. C. November 24, 1916.

Forest of Mount Rainier National Park. By G. F. Allen. Department of Interior, Office of Secretary. Washington. 1916. Pp. 32. Illustrated. Price 20 cents.

A brief discussion of the forest conditions and a popular description of the more important tree species found in the park.

The Vegetation of a Desert Mountain Range as Conditioned by Climatic Factors. By Forrest Shreve. Carnegie Institution of Washington. Publication 217. Washington. 1915. Plates.

Plant Succession. An analysis of the development of vegetation. By Frederick E. Clements. Carnegie Institution of Washington. Publication 242. Washington. 1916. Plates.

The Green Book. A manual for the use of lumbermen, woodsmen, and sportsmen, containing laws of the State of Maine relating to protection of the forests from fire; also other valuable matter, rules, tables, instructions, methods, and miscellaneous information. Kennebec Valley Protective Association. Bingham, n.d. Pp. 32.

Possibilities of Private Forest Management in New York State. By Cedric H. Guise. Agricultural Experiment Station, Ithaca. Bulletin 375. Ithaca. 1916. Pp. 697–746.

The Present and Future of Pennsylvania's Forests. By Hon. S. B. Elliott. The Pennsylvania Conservation Association. Dubois, Pa. 1916. Pp. 28.

Parasitism in Hymenochaete Agglutinans. By A. H. Graves. Reprint from Mycologia. Lancaster, Pa. November, 1914. Pp. 279–84.

Chemotrophic Reactions in Rhizopus Nigricans. By A. H. Graves. Reprint from Memoirs of the New York Botanical Garden. New York, N. Y. August, 1916. Pp. 323–31.

A Botanical Trip to North Wales in June. By Arthur H. Graves, Reprint from N. Y. Botanical Garden Memoirs. August. 1916. Pp. 167–72.

Instructions to Forest Fire Wardens of Vermont, 1916. Vermont Forestry Publication No. 22. n.d. Pp. 30.

Different Methods of Workmen's Compensation Insurance. By E. S. *Lott,* President U. S. Casualty Co., New York. December, 1916. Pp. 14.

Marketing of Woodlot Products. By J. W. Calland. Bulletin 302. Ohio Agricultural Exprimental Station. Wooster. 1916. Pp. 69.

Report of the Grading of Lumber. American Railway Engineering Association. Bulletin 84. January, 1916. Chicago. Pp. 407–14.

Report on Wood Preservation. American Railway Engineering Association. Bulletin 84. February, 1916. Chicago. Pp. 447–62.

Article on Test of Douglas Fir Bridge Stringers. By H. B. MacFarland. American Railway Engineering Association. Bulletin 84. February, 1916. Chicago. Pp. 281–467.

Western Rate Book. Northern Hemlock and Hardwood Manufacturers' Association. Oshkosh. 1916.

Root Rot of Coniferous Seedlings. By Arthur H. Graves. Reprint from Phytopathology. August, 1915. Pp. 213–17.

Marine Borers from Wood Preserver's Standpoint. A description of experiments to determine the effects of various fractions of creosote on borers. By L. F. Shackell. Railway Age Gazette. March 17, 1916. Pp. 508–10.

Wood Blocks for Street Paving: Their Treatment and Handling. Municipal Engineer. May, 1916. Pp. 183–84.

Experimental Studies of Strawboard Waste Purification. By Harry B. Hammon. Engineer and Contractor. May 24, 1916.

How to Control the Cottony Maple Scale. By J. G. Sanders. Wisconsin Department of Agriculture. Circular 2. Madison. 1916. Pp.4.

Report of State Forestry Board of Minnesota for 1916. St. Paul, Minn. Pp. 4.

I. Contributions to North American Euphorbiaceae—VI. II. Vegetation of Alacran Reef. By C. F. Millspaugh. Publication 187, Field Museum of Natural History, Botanical Series, Vol. II, No. 11. Chicago, Ill. 1916. Pp. 401–31.

Publications of the Field Museum of Natural History: Botanical Series, Volume II. Chicago, Ill. 1900–16. Pp. 433–47.

Ecological Investigation upon the Germination and Early Growth of Forest Trees. By R. H. Boerker. A thesis presented to the faculty of the graduate college in the University of Nebraska in partial fulfillment of requirements for the degree of Doctor of Philosophy, Department of Botany. Lincoln, Neb. 1916. Pp. 89. Plates 5.

Creosoted Wood-Block Paving. By W. Buehler.

Tests of Fire Retardents, with Special Reference to the Shingle Roof. By H. von Shrenk and A. von Schrenk.

Chicago's Four Million Dollar Pier.

Building Code Suggestions. (Fire Stops, Workmanship, Selection of Material.)

Building Code Suggestions. (Chimneys, Flues, Smokepipes, Fireplaces.)

Economics of Concrete and Timber Factory Buildings. By F. E. Davidson.

Interesting Comparison of Two Docks Recently Constructed in the City of Chicago, Ill.

Standard Specification for Creosoted Wood-Block Pavement.

Supplement to above.

Timber in Pier and Wharf Construction. Compiled by C. E. Paul and W. Buehler.

Technical Letters 1 to 9, National Lumber Manufacturers Association. May to September, 1916. Chicago, Ill. Pp. 4, 4, 4, 12, 12, 4, 4, 4, 14, 7.

Fifth Biennial Report, Department of Game and Fish, Alabama. October 1, 1914, to September 30, 1916. Montgomery. 1916.

A Forest Census of Alabama by Geological Divisions. Supplement to Monograph 8. By Roland M. Harper. Alabama Geological Survey. Reprint from Proceedings Society of American Forestry. 1916. Pp. 208–14.

The Effects of Certain Organic Compounds on Plant Growth. By M. J. Funchess. Alabama Agricultural Experiment Station. Bulletin 191. Technical Bulletin 1. Opelika. 1916. Pp. 103–32. Plates 8.

An Inventory of Florida's Forests and the Outlook for the Future. By Roland M. Harper. Florida Agriculture Department. Quarterly Bulletin., Vol. 26, No. 2. Tallahassee. 1916. Pp. 5–24.

Annual Report of Division of Parks and Recreation for Year Ended April 10, 1916. St. Louis. 1916. Illustrated.

Floors of Service for Factories, Foundries, Machine Shops, Mills, Warehouses, Platforms, Bridges, Loading Docks, Stables, Barns, Etc. Southern Pine Association. New Orleans, n.d. Pp. 31.

Noise—the Nerve Wrecker: How to Eliminate it in Your City. Southern Pine Association. New Orleans, n.d. Pp. 20.

Standard Specifications for Grades of Southern Yellow Pine Lumber. Southern Pine Association. New Orleans. 1916. Pp. 57.

What the Cities Say About Creosoted Wood-Block Pavements. Southern Pine Association. New Orleans, n.d. Pp. 24. Illustrated.

Expert Opinions of Creosoted Wood-Block Floors. Southern Pine Association. New Orleans. 1916. Pp. 8.

Proceedings of the Sixth Annual Meeting of the Southern Logging Association. Reprint from the Lumber Trade Journal. New Orleans, La. 1916. Pp. 100.

Root Rot of Coniferous Seedlings. By A. H. Graves. Reprint from Phytopathology. Baltimore, Md. August, 1915. Pp. 213–17.

Bud Weevils and Other Bud-Eating Insects of Washington. By M. A. Yorthers. Bulletin No 124, State College of Washington, Agricultural Experiment Station. Pullman. 1916. Pp. 43. Illustrated.

Shall the Stockman Pay? A letter written by E. H. Crabb to Wm. Babbitt, President of the Coconino Cattle Growers' Association, Flagstaff, Ariz., protesting against an increase in grazing fees on National Forests. Pp. 8. (Place of publication and date not given.)

Report of the Philippine Commission to the Secretary of War, 1915. Washington. 1916. Pp. 318.

Of interest is the annual report of the Bureau of Forestry, pp. 85–93, inclusive.

Forest Products of Canada, 1915: Pulpwood. Department of Interior, Forestry Branch. Bulletin 58 B. Ottawa, Canada. 1916. Pp. 11.

Report of the Director for 1915. Department of Interior, Forestry Branch. Ottawa, Canada. 1916.

Game Preservation in the Rocky Mountains' Forest Reserve. By W. N. Millar. Department of Interior, Forestry Branch. Bulletin No. 51. Ottawa, Canada. 1915. Pp. 69. Illustrated. Map 1.

A discussion of the various game animals of the region and their characteristics; advantages of each of the different kinds of game; and a plan of administration for the preserves.

Conservation of Fish, Birds, and Game. Proceedings at a Meeting of the Committee on Fisheries, Game and Fur-Bearing Animals, November 1 and 2, 1915. Commission of Conservation of Canada. Ottawa, Canada. 1916. Pp. 218.

Forest Products of Canada, 1915: Lumber, Lath, and Shingles. Bulletin 58 A, Dominion Forestry Branch. Ottawa, Canada. 1916. Pp. 31.

Third Annual Report of the Botanical Office of the Province of British Columbia, 1915. By J. Davidson. Vol. 1, Pt. 3. Victoria, B. C. 1916. Pp. 081–0150.

The "ABC" British Columbia Lumber Trade Directory and Year Book, 1916–17. Edited by J. H. Hamilton. Progress Publishing Co., Vancouver, B. C. 1916. Pp. 127. Price, $2.

Forest Products of Canada, 1915: Lumber, Lath, and Shingles. Department of Interior, Forestry Branch. Bulletin 58 A. Ottawa. 1916. Pp. 31.

Forest Products of Canada, 1915: Poles and Cross-Ties. Compiled by R. G. Lewis and W. G. H. Boyce. Bulletin 58 C, Dominion Forestry Branch. Ottawa, Canada. 1916. Pp. 9.

Market for Lumber in the Azores. By J. W. White. Commerce Report for April 22, 1916. Pp. 379.

Notes on the Tapping of Para Rubber. By W. G. Freeman. Trinidad and Tobago. Department of Agriculture. Bulletin, Vol. 15. Port-of-Spain. 1916. Plate 5.

Annual Return of Statistics relating to Forest Administration in British India for the Year 1914–15. Simla. 1916. Pp. 25. Diagram 1.

Annual Report of the Director of Forests (Queensland) for the Year 1915. Brisbane. 1916. Pp. 8. Illustrated.

Annual Report of the Department of Public Lands (Queensland, Australia) for the Year 1915. Brisbane. 1916. Pp. 110. Illustrated. Maps 3.

China and Forestry. By Dau-Yang Lin. Far Eastern Review. August, 1916. Pp. 105–10.

PERIODICAL LITERATURE

Owing to the irregularity and slimness of foreign forest literature, due to the war, this department must necessarily be meagre for the present.

Journal of Agriculture. Forestry Number. College of Agriculture, University of California. Vol. IV, No. 3, November, 1916. San Francisco, Cal. Pp. 49.

This special number devoted to forestry is as interesting and valuable to the forester as it is beautiful, and reflects great credit on the new Division of Forestry at California's University. The list of contributors to this number is a notable one, consisting of the dean of the University of Toronto's Forestry Department, an assistant forester, four district foresters, an inspector of grazing, the chief engineer of the Forest Service, the assistant to the Secretary of the Interior, two forest specialists, an expert on South American forests, a professor of forestry, the editor of The Timberman, and others.

The contents of this number are worth listing in detail:

"The Relation of Forests to Our Civilization," by Bernhard E. Fernow; "The Mountain Communities and the Forest Service," by Coert DuBois; "Grazing and Range Management," by L. F. Kneipp; "Game Farming in the National Parks and Forests," by Smith Riley; "Forest School Men and National Forest Work," by Paul G. Redington; "The Forest Fire Problems in District One," by F. A. Silcox; "Foresters in the Lumber Business," by W. B. Greeley; "The Principles of a Water Power Policy for the Public Lands of the United States," by O. C. Merrill; "The Grazing Resources of the National Forests," by James T. Jardine; "Opportunities for Forestry in South America," by H. M. Curran; "Opportunity and the National Parks," by Stephen T. Mather; "Wanted— A Forest Policy for California," by D. T. Mason; "The Production Capacity of the Douglas Fir Lands of Western Oregon and Washington," by T. T. Munger; "Forest Products," by Frank J. Hallauer; "Sawmills Today and in Retrospect," by Charles L. Trabert; "The Future of the Timber Industry on the Pacific Coast," by George M. Cornwall; "Health Problems in Forest Administration," by Luther Whitman; "The Work of the Division of Forestry of the University of California," "Creosoted Wood Blocks," "The Ranger," verse, etc. The number is finely illustrated, well gotten up, and with a most attractive cover design.

J. D. G.

NEWS AND PERSONAL NOTES

A meeting of the Forest Supervisors of District 1 will take place in Missoula the week beginning January 29. This is the first meeting which has taken place in three years. The program, very much in detail, has been prepared and it is expected to secure some very important results from the meeting.

Another distinct development of Forest Service work in District 1 is the decrease in the work handled by the Office of Lands. The classification of the Forests showing the agricultural and permanent forest land is rapidly being completed. The examination and settlement of the homestead claim situation is almost at an end. With the classification of agricultural lands completed, the work of handling applications for land under the Act of June 11, 1906, is very much decreased. This represents very decided progress, since with the questions of title and classification settled, the way for more rapid progress in forest management is open.

The Ranger School at the University of Montana reports an attendance of 28 men. This is the short course for a period of about three months during the winter. These men consist in part of rangers employed in the Forest Service, forest guards, employes of lumber companies, and woodsmen desiring additional training. The regular Forest School has an enrollment of 62 men. A new course for the ranger school has been added this season in grazing, embracing both range reconnaissance and range management. In addition, and rather supplementary to the ranger school at the University, the Forest Service will conduct a ranger conference for a period of two months at the Savenac Nursery. Twelve rangers will be in attendance, instructed by part of the force of the district office.

Early in the season of 1915, a number of the lookout points in District 1 were equipped with heliograph instruments at places where there was no hope of getting telephone connection in the near future. Nineteen complete sets were installed on as many lookout points. The first season very poor success was obtained, due to the lack of training of the operators and in part to a lack of interest. During the past

season it is reported that not to exceed 50 per cent of the instruments were successfully used. The longest distance reported across with satisfactory communication was maintained was 16 miles. The conclusions are that the heliograph instruments have been sufficiently successful to justify the expense of purchase and installation. Their success depends very largely upon the interest of the particular operators who are obtainable and the training which they receive. This is a very important field of training for students who expect to secure employment during the summer with the Forest Service. A student who is expert in handling the heliograph is more likely to obtain employment than those without this knowledge.

One hundred of the new 2½ pound portable telephones have been used in District 1 with entire success. The chief difficulty in the operation of telephone lines in the mountains is the interference of static electricity. During the hot, dry months this causes a pounding and frying noise on the lines, so that it is very difficult to talk. Mr. R. B. Adams expects to devote a considerable amount of time during the coming season in co-operation with the Western Electric Company in finding some instrument or other means to drain the lines of this static electricity.

The Federal holdings in the Appalachian and White Mountains were lately increased by 66,880 acres, bringing the total area up to 1,396,367 acres, distributed about half and half for the two regions. The new appropriation of three million dollars will be largely used to acquire tracts which are needed to round off the present holdings into solid blocks.

Two very important problems were discussed at the 37th annual meeting of the American Forestry Association at Washington, D. C., on January 18 and 19, namely, the question of recreational uses of National Parks and National Forests, and the problem of coping with the white pine blister rust. The last question naturally led to a discussion of stopping importations of tree and plant pests generally.

The following resolutions were adopted:

In view of the spread of disease and insect pests introduced from foreign countries, such as the chestnut blight, gipsy moth, and white pine blister, it is *Resolved*, That the American Forestry Association favor the principle of absolute national quarantine on plants, trees, and nursery stock, to take effect at the earliest date which may be found economically expedient. *Whereas*, The pine blister disease threatens to greatly injure the white pine forests of Eastern North America, and is a growing danger to the white pine timber of the West, and

its origin propagation and transmission being now generally understood. *Resolved,* That it is the sense of this conference that active measures should be taken by the duly constituted authorities and by all good citizens along the lines advocated by the officials competent to recommend practical measures for preventing further dissemination and, as far as possible, for the elimination of the disease. *Resolved,* That immediate action should be taken by the Federal Governments of the United States and Canada for adequate quarantine measures to prevent the spread of the disease to sections of the continent not now known to be infected. *Resolved,* That cooperation by the Federal Governments with States and Provinces to eradicate or control the disease in sections now infected should be continued and extended by liberal appropriations. *Resolved,* That the States and Provinces, both independently and by interstate, national, and international cooperation, are urged to conduct complete investigations, provide proper quarantines, and take all necessary measures, in keeping with the seriousness of the situation, to eradicate or control the pine blister disease. *Resolved,* That a copy of these resolutions be transmitted to the Secretary of Agriculture, to the chairman and members of the United States House and Senate Committee on Agriculture and Forestry, to all members of the United States Senate, and to the Governments of the Dominion of Canada and of the Canadian Provinces.

The Canadian Forestry Association, which in spite of the war, through its very active secretary has been most assiduous in instructing the public on various forestry problems, held its annual meeting at Ottawa on January 15. The problem of the white pine blister rust occupied the leading part of the discussions, provincial and federal authorities being represented. White pine blister rust has been located in the Niagara Peninsula and in Simcoe, Durham, Wellington, and Victoria counties of Ontario, as well as in Quebec near Montreal.

The most important move during the year, for which the association has been largely responsible, was a reorganization of the forest protective service of Ontario under a new department, Mr. E. J. Zavitz, Provincial Forester, having been appointed head of the department.

Other Provinces have also been brought into line, particularly making the "burning permit" for settlers a requirement.

The Norwegian Forestry Association has recently appropriated 50,000 kroner (about $12,500) to provide for an accurate collection of forest statistics in Norway to be conducted by the Central Statistical Bureau of the government.

M. A. E. Saxlund was retired as Director of Forestry in Norway on January 1, 1917, with a pension of 3,500 kroner per year (about $875). Mr. Saxlund was director of forestry for many years, during which the receipts from state forests increased from 700,000 kroner to 2,500,000 kroner (about $175,000 to $625,000). For the present year a cut has been planned, valued at 5,000,000 kroner (about $1,250,000).

The Forestry Club of the University of California proposes to publish a monthly magazine similar to the California Journal of Agriculture, but devoted to forestry subjects and the work of the Forest Service in California. Five hundred odd subscriptions at $1 per year to the proposed journal were promised by the men in attendance at a ranger meeting in Berkeley the latter part of December.

The forest academy at Eisenach, in the Grand Duchy of Saxony, ceased to exist on January 1, 1916. The academy was founded by Dr. König as a private institution but, in 1830, became the official forestry institution of the Grand Duchy. Dr. Matthes was the last director of the academy. The course covered two years.

Mr. H. M. Curran, now instructor in the department of tropical forestry at the Yale School of Forestry, is planning for a tropical experiment station and research laboratory in continental South America. The lines of research are to be tropical diseases; a system of colonization and education suitable to tropical lands; the productivity of the soil and most suitable crop, the mineral wealth, water powers, and other resources. Mr. Curran has great confidence in the possibility of developing forest resources for northern markets satisfactorily, and especially in their reproduction under low rotation.

A fund of $500,000 a year for 20 years is to be the ambitious basis for this enterprise.

Dr. Joseph A. Holmes, who died in July, 1915, was a man to whom the cause of forestry has been indebted in more than one way. As director of the Geological Survey of North Carolina, he was responsible for making forestry a part of that Survey, and those who were pressing for the Appalachian National Forest will remember him as a staunch and active supporter. His special field, however, finally became the movement to secure greater safety in the working of mines. In appreciation of the great importance of this work, to which he devoted his last years with such devotion and signal success, his friends have organized The Joseph A. Holmes Safety Association, the object of which is to stimulate effort in this direction by awarding medals and honorariums to those originating, developing, and installing the most efficient safety-first devices each year. Contributions toward the fund needed are solicited by Dr. David T. Day, 1333 F Street N. W., Washington.

It would appear that, if personal contributions may not be expected from foresters, the American Forestry Association and the Society of American Foresters in their corporate existence could fittingly contribute and thereby express recognition of Dr. Holmes' services to the forestry cause.

One of the early forestry advocates, William Rane Lazenby, professor of forestry at the Ohio State University, died of pneumonia on September 14, 1916, at the age of 66 years. He came to forestry through horticulture, in which he held an assistant professorship at Cornell University, creating the horicultural department at that institution. In 1881, he was called to Ohio University as professor of botany and horticulture, and in 1892 changed to professor of horticulture and forestry, since 1910 restricting himself to the latter subject entirely.

Coming to Ohio just about the time when through the Forestry Congress at Cincinnati the subject of forestry assumed interest by the public, he became at once a member of the Congress, subsequently the American Forestry Association. He contributed many papers to its proceedings and its propaganda. It was due to his personal efforts that the forest school at Ohio University was established. His friends mourn the loss of a genial and always helpful associate.

1. *Northeastern United States and Eastern Canada*

On October 11, J. J. Levison took up his work as forester for the Park Department, Borough of Manhattan, New York City.

D. E. Lauderburn is in charge of the Department of Timber Estimating, Forest Management, and Forestry Planting for the Kelsey Forestry Service, 150 Broadway, New York, N. Y.

Austin F. Hawes has resigned from the State forestership of Vermont to enter the States Relations Service of the U. S. Department of Agriculture in charge of the work of forest extension in the Northeastern States.

A. B. Hastings has been appointed Assistant State Forester of New Hampshire.

F. A. Gaylord and Miss Marjorie Forbes were married at Olean, N. Y., on October 18.

Kenneth R. Vavasour has resigned from the Dominion Forestry Branch to enlist with the 226th Forestry Battalion.

Percy S. Hamilton (Biltmore, 1911) was married on December 4 to Miss Clair A. Birch, of St. Johnsbury, Vt.

Professor Gheen leaves the New York State College of Forestry at Syracuse in February to take a position with the Southern Pine Association.

E. I. Tinkham, a student in forestry at Cornell, has been awarded the Croix de Guerre for gallantry while serving with the American Ambulance Corps in France.

B. K. Ayres has given up his position with the Ansonia (Conn.) Forest Products Co., and has moved to Concord, N. H., where he will operate on his own timberlands.

2. *Southern United States*

Charles Claxton, of the Forest School at Pennsylvania State College, has accepted the position of teacher of forestry at Lincoln Memorial University, Tennessee.

W. R. Mattoon has, since November 15, been in charge of forest extension in the Southern States for the States Relations Service.

Geo. De S. Canavarro resigned on October 1 from his position with the National Museum, in order to devote all his time to the American Pasteurizer Co., of Washington, D. C., of which he is vice-president.

J. S. Kaplan was married November 25 to Miss Carol Umholtz, of Buena Vista, Va.

O. C. Merrill has been appointed Chief of the newly established Branch of Engineering in the Forest Service at Washington, D. C.

W. A. Hopson, Forest Examiner in District 7 of the Forest Service, has resigned.

3. *Central United States*

W. Irving Gilson is now Assistant Professor of Forestry at Michigan Agricultural College.

Raymond F. Kroodsma has taken a position with the Stiles Brothers Lumber Company, of Grand Rapids, Mich.

Frank B. Moody has been re-appointed one of the Conservation Commissioners of Wisconsin for a term of six years.

Roy D. Thomas (Biltmore, 1910) is general manager of the National Forestry Company, Cadillac, Mich.

C. W. Armstrong, of Minneapolis, is now with the Salmon River Lumber Co.

Willam Rane Lazenby (Cornell, '74), Professor of Forestry at Ohio State University, died on September 15, at the age of 65.

Prof. Filibert Roth, of the University of Michigan, has been elected President of the Society of American Foresters, succeeding Dr. Fernow.

4. *Northern Rockies*

Clinton G. Smith is giving the course in National Forest Administration at the Yale Forest School.

Fred R. Johnson is now Chief of Planting at the Denver office of the Forest Service.

R. P. Imes, hitherto Supervisor of the Harney National Forest, has resigned.

J. H. Ramskill, Forest Examiner in District 2, of the Forest Service, has resigned. His present address is Nam Tu, Upper Shan States, Burma, India, where he is with a mining company.

5. *Southwest, Including Mexico, Central and South America*

H. M. Curran has recently been appointed Lecturer on South American Forests at the Yale School of Forestry. On February 7 he and M. B. Haman (M. F., Cornell, 1916) left for a protracted timber cruise in Colombia and Venezuela.

Bartle T. Harvey sailed recently for Rio de Janeiro, where he has taken a position in the Brazilian Bureau of Entomology.

6. *Pacific Coast, Including Western Canada*

The wedding of Austin Cary and Miss Leila J. Chisholm, of Seattle, occurred on October 18.

David G. Kinney has opened an office as consulting forester at 453 Holland Avenue, Los Angeles.

H. R. Macmillan has resigned as Chief Forester for British Columbia to become assistant to the manager of the Victoria Lumber and Manufacturing Co.; address, Chemainus, B. C. He is now a fellow of the Royal Geographical Society.

M. A. Grainger, hitherto chief of records in the B. C. Forest Branch, has been appointed Chief Forester to succeed Macmillan.

Capt. J. B. Mitchell, formerly Deputy District Forester of the Vancouver District, was killed in action on September 15.

John D. Gilmour, of the B. C. Forest Branch, has resigned in order

to become general logging superintendent of the Anglo-Newfoundland Development Co., Grand Falls, Newfoundland.

Geo. W. Thompson (Biltmore, 1911), formerly with the Hammond Lumber Co., has opened an office as forest engineer at Winlock, Wash.

7. *Hawaii, the Philippines, and the Orient*

The present address of Oliver F. Bishop is Kisavan, Asahan, Sumatra, Dutch East Indies.

Devillo D. Wood, a graduate in Forestry at Michigan Agricultural College, 1911, is now Assistant Conservator of Forests in British North Borneo. The Conservator, D. M. Matthews, University of Michigan, 1909, has been in India since November.

A forest school, the first of its kind in Australia, has been established at Creswick, on the Dividing Range, some 10 miles northward of Ballarat. Pupils are accepted between the ages of 14 and 16, after passing a competitive and medical examination, and are required to go through a course of training for three years. The aim of the Forest Department throughout has been to give students a thorough training in practical forestry, while giving class teaching its due place. The subjects taught are: English, Arithmetic, Algebra, Botany, Geology, Physics, Chemistry, and Surveying. Daily instruction is also given in a large tree nursery near the school, where the annual output is over 4,000,000 plants. A pine plantation of some 700 acres bearing conifers from 12 to 22 years old surrounds this nursery, and the students are given regular training in planting, thinning, measurement, and estimating of timber crops, felling, and conversion of timber, on this area. In the vicinity there are also two large reserves of natural forest. In these, students have the opportunity of studying the habits, growth, and methods of felling and converting eucalyptus timber.

SOCIETY AFFAIRS

Report of the Treasurer for the Year Ending December 31, 1916

RECEIPTS

Balance from previous year				$369.25
Annual dues:				
Active members, 1914	$6.00			
1916	897.50			
1917	32.00			
1918	3.00			
		$938.50		
Associate members, 1916	$86.00			
1917	2.00			
		88.00		
			$1,026.50	
Proceedings:				
Subscriptions,				
Vol. IX (1914)	$2.00			
Vol. X (1915)	22.00			
Vol. XI (1916)	521.50			
Vol. XII (1917)	26.50			
		$572.00		
Sale of back numbers		135.50		
Sale of separates		7.45		
			714.95	
Interest on bank deposit:				
January 1 to June 30, 1916		$7.70		
July 1 to December 31, 1916		7.69		
			15.39	
Society pins			107.25	
Miscellaneous:				
Balance from smoker on January 22, 1916		$17.25		
Overpayments, duplicate payments, etc.		9.35		
Binding for Texas Agric. and Mech. College		8.40		
			35.00	
Total				1,899.09
Grand total				$2,268.34

DISBURSEMENTS

Publication and distribution of Proceedings:				
Printing 600 issue, Vol. XI	$949.96			
Electrotyping	36.65			
Proof-reading	69.00			
Envelopes for mailing	28.75			
Addressing and mailing	9.50			
Postage and express	31.83			
		$1,125.69		
Printing 200 reserve, Vol. XI		89.66		
			$1,215.35	
Miscellaneous printing:				
Notices of meetings		$11.00		
Circulars and ballots		75.75		
Proof-reading, circulars and ballots		2.40		
			89.15	
Stationery:				
Letter-heads		$8.50		
Second sheets		1.25		
Carbon sheets		1.25		
Form letters		5.00		
Bill heads		8.50		
Envelopes		12.80		
Coin envelopes (for stencils)		.45		
Index cards		4.00		
Receipt book		.05		
			41.80	
Postage			76.95	
File clerk, stenography, and typewriting			62.02	
Addressing notices, envelopes, etc			3.52	
Express, telegraph, and telephone			1.73	
General meetings:				
Washington meeting, Jan. 22		$27.50		
New York meeting, Dec. 29		3.50		
			31.00	
Society pins			107.25	
Miscellaneous:				
Refunds, etc		$8.12		
Binding for Texas Agric. and Mech. College		8.40		
Binding back numbers for Society		6.00		
Stencils		2.79		
			25.31	
Total				$1,654.08
Balance on hand				614.26
Grand total				$2,268.34

ASSETS

Balance on hand			$614.26
Annual dues:			
C. A. Schenck, 1915–1916			6.00
Proceedings:			
Subscriptions, Vol. X (1915):			
Vaughan Jones		$2.00	
Subscriptions, Vol. XI (1916):			
J. B. Berry	$2.00		
G. T. Curtis	2.00		
Vaughan Jones	2.00		
D. E. Lauderburn	2.00		
Kansas State Agric. College	2.00		
		10.00	
Back numbers and separates:			
Baker and Taylor Co	$1.50		
E. C. Hirst	.75		
		2.25	
			14.25
Postal deposit			9.70
Stencil coupons			.44
Total			$644.65

LIABILITIES

Dues paid in advance:				
Active members, 1917	$32.00			
1918	3.00			
		$35.00		
Associate members, 1917		2.00		
			$37.00	
Subscriptions to Proceedings, Vol. XII (1917)			26.50	
Total				63.50
Excess of assets over liabilities				$581.15

The budget approved by the Executive Committee for the past year differed somewhat from that of the previous year both in the method of allotting funds to the various activities of the Society and in controlling expenditures under these allotments. All estimated receipts from sales of the Proceedings (including $2 for each member of the Society), which amounted to $1,280, were allotted to the publication and distribution of the Proceedings, and the Editor-in-Chief was authorized to spend up to, but not more than, this amount. The remaining estimated receipts (including $1 from each Active member,

interest on bank deposit, and miscellaneous receipts), which amounted to $340, were distributed among the general activities of the Society. Officers and chairmen of committees were then authorized to incur routine expenditures in the handling of current work, such as issuing notices of meetings, securing suitable stationery, necessary clerical help, postage, etc. They were, however, instructed not to incur any unusual expenditures, such as the issuing of special circulars, without first conferring with the Treasurer. The latter would then authorize the expenditure if the approved allotment for the purpose were sufficient to justify such action; or if not, would refer the matter to the Executive Committee for decision. In addition the chairman of the Committee on Meetings was authorized to spend not more than $50 for general meetings.

This arrangement has worked well and has led to an economical handling of the Society's funds without interfering in any way with the prompt transaction of its business. How closely actual recepits and disbursements checked with the estimates can be seen from the following comparison. This does not include payments for pins, overpayments, refunds, etc., for which no provision was made in the budget and in which receipts and disbursements were exactly equal. It is particularly interesting, and also encouraging, to note that while in a number of cases we received more or spent less than we had estimated, in only one item, postage, did the actual exceed the estimated expenditures by any considerable amount.

RECEIPTS

	Estimated	*Actual*	*Excess of actual over estimated*
Annual dues, Active members...	$927.00	$938.50	$11.50
Associate members........	92.00	88.00	−4.00
Proceedings, subscriptions......	510.00	572.00	62.00
Sale of back numbers and separates................	60.00	142.95	82.95
Interest on bank deposit.......	13.00	15.39	2.39
Miscellaneous..................	18.00	18.48	.48
Total....................	$1,620.00	$1,775.32	$155.32

DISBURSEMENTS

Publication and distribution of Proceedings	$1,280.00	$1,215.35	$-64.65
Miscellaneous printing	85.00	89.15	4.15
Stationery	35.00	41.80	6.80
Postage (exclusive of Proceedings)	60.00	76.95	16.95
File clerk, stenography, and typewriting	85.00	62.02	-22.98
Addressing notices, envelopes, etc	10.00	3.52	- 6.48
Express, telegraph, and telephone	5.00	1.73	- 3.27
General meetings	50.00	31.00	-19.00
Directory, Washington Academy of Sciences	5.00	0.00	- 5.00
Miscellaneous	5.00	8.79	3.79
	$1,620.00	$1,530.31	$-89.69

In other words, we have actually received $155.32 more and spent $89.69 less than we estimated, making a net gain during the year of $245.01. Since this is the first time since 1911 that there has not been a net loss, such a substantial increase in our balance is decidedly noteworthy. It is evidently due in part to economies in administration, in part to increased subscriptions to the Proceedings, and in part to several large sales of back numbers. In this connection it is worth noting that during the past year the expense of publishing and distributing the Proceedings has amounted to 38 cents a copy for an edition of 800 copies. As a consequence, every copy sold now means a net return to the Society instead of a net loss, as has sometimes been the case in the past when the cost of printing has amounted to more than the price at which single copies are sold (50 cents).

In the present report the custom of previous years has been followed of not reporting the Society's supply of back issues of the Proceedings as an asset. That these actually have a considerable value is, of course, obvious, but it has seemed best not to include them in the financial statement because this value is a difficult one to appraise and because it cannot be converted into cash at will. The suggestion of the former Treasurer that the proceeds from the sale of back numbers be used to defray the expense of printing the reserve supply of 200 copies of the

Proceedings was followed this year in the preparation of the budget with satisfactory results, since such sales yielded a net return of $45.84 after providing for the reserve.

So far as next year is concerned, while it would of course be out of place for me to attempt to present a detailed budget at this time, a few general statements regarding probable receipts and disbursements may be of interest. I understand that the Editorial Board desires an allotment of $2,600 to cover the publication of the new Journal of Forestry. At least $400 more should be allowed for running expenses ($331.48 was actually used for the purpose during the past year), making a total expenditure of $3,000. To meet this we have in sight, roughly, the following receipts:

	Journal of Forestry	*Running Expenses*
Annual dues, 322 active members ($3 each allowed for Journal; $2 for running expenses)	$966	$644
Subscriptions:		
25 associate members	75	....
270 regular subscribers to Proceedings	810	....
14 student subscribers to Proceedings	21	....
370 subscribers to Forestry Quarterly	1,110	....
Sale of back numbers of Proceedings	75	....
Interest on bank deposit	....	15
Miscellaneous	....	9
Total	$3,057	$668

This estimate assumes that all present subscribers to either the Proceedings or the Forestry Quarterly will continue their subscriptions to the Journal of Forestry and that approximately half of the Associate members will subscribe. On the other hand, it makes no allowance for new members, new subscriptions, or advertising. I believe, therefore, that it is safe to predict that if the Editorial Board is able to issue the Journal for $2,600, as estimated, the Society will be able not only to avoid a deficit, but even to add to its present balance.

S. T. Dana,
Treasurer.

Accounts audited and found correct.

C. G. Bates,
C. F. Korstian,
Auditing Committee.

Report of the Secretary for the Year Ending December 31, 1916

MEETINGS

The Society held ten meetings during the year 1916. Of these eight, the annual on January 22, and seven open, were in Washington and two outside—one open meeting at Asheville, N. C., in connection with the meeting of the Southern Forestry Congress on July 14, and another at New York on December 29. This last was in connection with the annual sessions of the American Association for the Advancement of Science. Both of these were well attended, at Asheville about 21 members being present, and at New York about 35. It is a matter of gratification that meetings which have been held outside of Washington have been well attended, since it indicates a growing interest in forestry and also the extent to which professional foresters are distributed over the country. The open meetings in Washington were all held during the winter and spring of 1916. In the fall a local section of the Society was established at Washington and all open meetings during this period were held under its jurisdiction and this will continue to be the case in the future.

MEMBERSHIP

At the end of 1916 the total membership of the Society was 386, including 15 honorary, 49 associate, and 322 active. The additions to the membership during the year were 1 honorary, 27 associate, and 73 active, 2 of the last consisting of transfers from associate membership. During the year the Society lost only 4 members, all of whom were active, 2 through resignation and 2 who were dropped through delinquency in the payment of dues. The net gain in membership during the year was 1 honorary, 25 associate, and 69 active, or a total of 95. Three duly elected candidates for active membership and 7 for associate membership either did not reply to their notice of election or declined membership. Through death the Society lost a friend and former associate member, Mr. C. A. Davis, of the Geological Survey.

The details of the various changes follow:

New Enrollments

Active Members

W. T. Andrews
F. S. Baker
John Bentley, Jr.
Philip Brooks
A. L. Brower
F. H. Brundage
R. H. Campbell
F. G. Clark
J. R. Coolidge, III.
R. L. Deering
R. Dieffenbach
N. B. Eckbo
H. E. French
W. H. Gibbons
G. A. Gutches
B. L. Gröndal
E. J. Hanzlik
A. B. Hastings
B. F. Heintzleman
A. H. Hodgson
A. F. C. Hoffman
B. E. Hoffman
J. V. Hofmann
W. A. Hopson
W. I. Hutchinson
J. S. Illick
A. J. Jaenicke
D. S. Jeffers
F. R. Johnson
H. M. Johnson
D. P. Johnston *
W. H. Kenety
A. F. Kerr
A. H. King
C. F. Korstian
G. N. Lamb *
E. H. MacDaniels

Active Members

H. R. MacMillan
A. C. McCain
E. F. McCarthy
R. E. Marsh
W. Metcalf
R. B. Miller
J. C. Nellis
H. B. Oakleaf
W. B. Osborne
D. Parkinson
P. J. Paxton
R. Philips
G. C. Piché
Quincy Randles
Verne Rhoades
F. H. Sanford
J. B. Saxton
C. H. Shattuck
E. C. Shepard
E. A. Sherman
A. A. Simpson
J. B. Somers
W. N. Sparhawk
C. J. Stahl
C. M. Stevens
J. W. Stokes
M. J. Sweeney
A. H. Sylvester
M. W. Thompson
T. R. Truax
H. C. Williams
M. H. Wolff
Herman Work
I. T. Yarnall
L. J. Young
E. J. Zavitz

Associate Members

C. C. Adams
G. F. Allen
J. R. Barber
N. L. Britton
A. F. Burgess
L. E. Cooper
H. C. Cowles
L. H. Douglas
H. H. French
R. M. Harper
H. D. House
W. R. Kreutzer
J. MacLaren
G. E. Marshall
O. C. Merrill
E. W. Nelson
J. W. Nelson
T. W. Norcross
T. S. Palmer
L. H. Pammel
R. J. Pool
G. D. Pratt
H. A. Reynolds
P. S. Ridsdale
E. W. Show
F. Shreve
J. S. Whipple

Honorary Member

J. T. Rothrock

*Transferred from Associate Membership.

Declined membership or never replied to notice of election

Active Members	*Associate Members*
W. G. Baxter *	H. W. Barre
J. M. Redford *	I. Bowman *
T. Shoemaker	E. N. Kavanagh *
	J. E. Kirkwood
	B. E. Livingston
	D. T. MacDougal
	E. Shaeffle *

Elected Nov. 17, 1916, but membership not yet accepted.

Active Members

E. T. Allen	S. St. J. Malven
G. H. Cecil	James Rogers
J. W. Girard	

Loss in Membership

Active Members

By Resignation	*Dropped for non-payment of dues*
H. H. Fahrquhar	Geo. de S. Canavarro
A. D. Read	J. F. Bruins

CONSTITUTIONAL CHANGES

Some far-reaching constitutional changes were submitted to the members of the Society during the year. Briefly these proposed changes were in the classification of membership; the creation of an Executive Council with enlarged powers in place of the Executive Committee; increase of annual dues to active members from $3 to $5 and elimination of dues for associate and honorary members with the provision that these two last named classes of members should not receive the official organ of the Society except by subscription; and finally the amalgamation of the Proceedings of the Society of American Foresters with the Forestry Quarterly. With the exception of the provision for changing the classes of membership all of the amendments carried. Attention is called to the fact, however, that out of a total voting membership of approximately 300, ballots were returned from only 128.

ADMINISTRATIVE CHANGES

During the year there were 42 of the badges adopted as the official emblem of the Society sold to its active members.

*Did not reply to notice of election.

In accordance with the suggestion in the report of the Secretary for 1915, colored carbon paper was adopted in order to distinguish it from the white paper used in the official correspondence of the Forest Service.

The regular subscriptions to the Proceedings during the year were 273 in number, students' subscriptions 15, a total of 288 in all. The amalgamation of the Proceedings with the Forestry Quarterly will probably add over 300 additional regular subscriptions to the American Journal of Forestry, this being a point concerning which it is impossible to make a definite statement until the matter has been taken up with these subscribers. The total number of the back numbers of the Proceedings on hand on January 11 was 3,143.

Publications of Society on Hand, January 11, 1917

Proceedings	*No. on Hand*	*Proceedings*	*No. on Hand*
Vol. I, No. 1	159	Vol. VIII, No. 1	43
Vol. I, No. 2	167	Vol. VIII, No. 2	56
Vol. I, No. 3	127	Vol. VIII, No. 3	93
Vol. II, No. 1	201	Vol. IX, No. 1	2
Vol. III, No. 1	92	Vol. IX, No. 4	108
Vol. IV, No. 1	79	Vol. X, No. 1	275
Vol. IV, No. 2	181	Vol. X, No. 2	200
Vol. V, No. 1	3	Vol. X, No. 3	204
Vol. VI, No. 1	84	Vol. X, No. 4	203
Vol. VI, No. 2	76	Vol. XI, No. 1	151
Vol. VII, No. 1	62	Vol. XI, No. 2	175
Vol. VII, No. 2	85	Vol. XI, No. 3	154
		Vol. XI, No. 4	163

Separates	*No. on Hand*
"Biography of the Southern Appalachian and White Mountain Regions"	40
"Uniformity in the Forest Fire Legislation Affecting Railroad Operation and Lumbering"	30
"Forestry in America as Reflected in the Proceedings of the Society of American Foresters"	16

In this connection the rapidity with which some of the numbers of the Proceedings have been sold out makes it seem advisable in the future to create a larger reserve than has been the practice in the past. With the amalgamation of the Forestry Quarterly with the Proceedings it

seems more than likely that there will be a still greater call for single copies and even for entire volumes by those who are not members of the Society. If, as has been suggested, an index to the back numbers of the Proceedings is issued, and this can be given a rather wide distribution to libraries where it can be consulted freely, the call for back numbers should be still greater than has been the case up to the present. It is earnestly recommended, therefore, that this index be published, since it is the Secretary's belief that it will result in turning back numbers now on hand into more of a tangible asset than they are at present. The question comes up as to the advisability of creating a small reserve, about 10 of each number, which can be kept for any particular purpose that may arise in the future.

The Secretary would like to suggest the desirability of combining the offices of Secretary and Treasurer into one office of Secretary-Treasurer. As matters now stand, the work of the two offices is so closely related that nominees for them must be chosen from men who are practically in daily contact, and it is even desirable that each year one of these officers be reelected in order that he may assist any newly elected candidate to the other position. Under the present system the Secretary handles the mailing of the Proceedings and the Treasurer must, of course, submit the invoice for them. There is a very good opportunity, although no cases where it has occurred are known, of the Proceedings being mailed without being billed. With the offices combined, there can be a still closer coordination of the work than there is at present with much less probability of errors. Under the present arrangement, of course, where the work is all carried out by men on contributed time, it may be too much to ask that any one man handle the position of Secretary and Treasurer, but as soon as the funds of the Society will permit, these two offices should be combined into that of a paid Secretary-Treasurer. Possibly some arrangement could be made whereby this officer need not be a member of the Society, in which case, some expert in this line could be employed who would only need to give a little of his time to it.

Respectfully submitted,

C. R. Tillotson,
Secretary.

The supply of Volume V of the Proceedings of the Society of American Foresters is entirely exhausted. This volume is, accordingly, no longer available for sale by the Society.

Report of the Executive Committee

January 17, 1917.

The members of the Society of American Foresters have been well informed of the principal activities of its Executive Committee during the past year through the discussion of and balloting upon proposed changes in the Constitution and in the conduct of the Society's publication. Through the ballot, which was taken on December 1, all of the matters referred to the Executive Committee by the preceding committee and by the Society at the executive meeting in January, 1916, have been brought to a conclusion, with one important exception. Formal action has been taken to amalgamate the Proceedings of the Society with the Forestry Quarterly in a new publication of eight issues per year, to be known as the Journal of Forestry. Detailed arrangements for the handling of the new journal are now being worked out by the Editorial Board in collaboration with Dr. Fernow. The dues of Active members have been advanced to $5 per annum, a step which not only assures adequate financial support for the new publication, but also provision for supporting effectively the scientific work of the Society which should be aggressively developed. Another important forward step has been taken in modifying the Constitution of the Society so as to correlate all of its officers and governing bodies more effectively through an Executive Council.

The exception in the matters intrusted to the Executive Committee, which has not been brought to a definite conclusion, is the reclassification of membership with a suitable modification of the membership provisions in the Constitution. The Executive Committee felt that changes in this fundamental feature of the Society's organization should not be made without very thorough consideration and opportunity for an expression of views. Accordingly, not only was a definite period provided for the discussion of proposed changes after a ballot had been prepared and distributed, but the ballot itself proposed two alternative sets of amendments incorporating substantially the two outstanding lines of development which had been suggested. The vote of the Society upon this ballot indicated clearly that a large majority of its members favor a broadening and reclassification of the basis of membership; but that they are almost equally divided as between the alternative schemes proposed. Since this ballot was taken, the Executive Committee has given careful study both to the vote itself as an expression of opinion and to the many suggestions and opinions which have been elicited during the entire consideration of this question. It is felt beyond any doubt that the officers of the Society are now in a

position to formulate a single set of amendments drawing upon both of the proposals previously submitted which will meet the views of a majority of the members and be adopted by a substantial vote. These amendments should provide for the grade of Fellow, primarily an honorary grade without exclusive prerogatives, the election to this grade retaining the requirement of recognized accomplishment in responsible directive positions or distinctive individual work and to be confirmed by the vote of the entire Society. There should be, secondly, a grade of Member, retaining full prerogatives as to holding office, elections to which will be made by the Executive Council upon largely prescribed and mechanical qualifications. A third grade, of Junior member, will permit broadening the membership of the Society to include younger and less experienced men and men without technical training, along the lines advocated in one form or another by a large majority of those who participated in the recent dicussion. A set of amendments along these lines will be submitted to the incoming Executive Council in the near future, for its consideration as the basis for preparing a further ballot on the subject.

The outgoing Executive Committee will also recommend to the Executive Council that it determine how the wearing of the insignia of the Society or the adoption of special badges for certain classes of members shall be adjusted, upon the completion of the final ballot. This point came up during the discussion, and, it is felt, can be properly handled by the Executive Council.

During the year, the Executive Committee has approved requests for the establishment of four local Sections of the Society: at San Francisco, Cal., Denver, Colo., Washington, D. C., and Ogden, Utah. The creation of a Section at Washington was carried out in accordance with a suggestion made at the meeting of the Society in San Francisco, at the Panama-Pacific Exposition, with a view to putting the members of the Society at Washington upon exactly the same footing as those in other portions of the country in regard to their relations to the parent organization. The Executive Committee is very much gratified to report the establishment of the three additional Sections in the Western States. The Society now contains eight local Sections, with branches at Albuquerque, N. Mex., Portland, Oreg., Missoula, Mont., and St. Paul, Minn., in addition to the four above named. There can be no question as to the desirability of these local organizations. They have already proved their value as a medium for discussion and crystallizing of ideas in connection with the consideration of the recent constitutional amendments, as well as in their current local meetings

and discussions of technical subjects. The Executive Committee expresses the hope that the Section organization of the Society may be extended into the Eastern States, including the affiliation of local forestry clubs or like organizations. This is felt to be in every respect a logical and normal growth of the Society along the lines necessary to make it most useful under the conditions in which the work of our membership is cast.

In the general field of developing the scientific work of the Society, arrangements have been made for the publication of the complete report of the Committee on Terminology, probably as a separate issue of the Journal of Forestry, with a sufficient number of reprints to supply all demands for the use of this extremely valuable glossary of American forestry terms. The publication of this work, for which the Committee on Terminology, headed by Dr. Fernow, is to be very highly commended, represents a definite step in the scientific work of the Society, the completion of which is certainly a matter of congratulation.

The holding of a special meeting in connection with the American Association for the Advancement of Science at New York is another valuable step of this character. The meeting of this year was very successful from every standpoint, and there is no question that the Society acted wisely in its decision a year ago to make such meetings a permanent feature of its work.

As a further development along the lines of technical leadership, the Executive Committee feels that the Society might well take up actively the general subject of formulating through the Society or with its aid a plan for assembling in convenient form for comparison and reference data on all forest investigations, being conducted or proposed, by all agencies in the United States and Canada. These data would necessarily be very condensed in form but should be sufficient to indicate the character and scope of each investigation. The making up and publication of a program of American forest investigations which could thus be arranged for would be of very great value as the first step in correlating investigative work in forestry, avoiding duplication, and putting different investigators on the same subject in touch with one another. It is felt that it would be desirable for the Executive Council to take up this matter, perhaps as the next step of a constructive scientific character upon which the Society might concentrate its energies.

Respectfully submitted,

For the Executive Committee,

W. B. Greeley,

Chairman

Report of the Editorial Board

January 18, 1917.

Inasmuch as the management of the Proceedings of the Society during the year 1916 has been along normal and well-established lines, the retiring Editorial Board at this time wishes to confine its report to the future of the official organ. Financial problems and questions of distribution involved in the future issuance of the organ are covered in the report of the Treasurer.

By its December ballot, the Society has sanctioned the amalgamation of the Proceedings with the Forestry Quarterly and this amalgamation is now an accomplished fact. The name adopted for the new publication, as proposed in the ballot, is to be the Journal of Forestry. The Journal will henceforth appear eight times each year at monthly intervals, with the omission of the summer months. Its size will be from 100 to 150 pages per issue and will incorporate the best features of the two parent publications. Since the Journal is to be the organ of the profession and the Forestry Quarterly was the first professional organ in the field it seemed advisable to retain the continuity of the old and original forestry publication, by giving the first volume of the new Journal the number XV in succession to the 14 volumes of the Quarterly already extant.

The contents of the Journal will represent the following departments:

Original Articles
Notes and Comments
Reviews
Recent Publications
Periodical Literature
News and Personal Notes
Society Affairs

Under the new arrangement for editing and publication, Dr. B. E. Fernow, it is understood, is to be appointed by succeeding presidents of the Society as Editor-in-Chief as long as he is willing to discharge these duties and as long as such action is consistent with the interests of the Society. Under appointment by the President of the Society, Mr. Zon will serve as the managing editor of the Journal. As has been the custom with the Proceedings, the material for the Journal will be made up in Washington under Mr. Zon's direction. As a private enterprise, Mr. Ballard will prepare manuscripts for the printer and read the proofs as he has been doing for some time past. His experience in this line has saved a great deal of expense and trouble to the Society.

The Editorial Board, consisting of nine members in all, will divide the fields of endeavor along the following lines:

Forest Utilization
Forest Finance
Forest Ecology
Mensuration and Organization
Silviculture
Technology
Policy and Administration
Forest Economics

The editor in charge of utilization will also be given special responsibilities in looking after matters pertaining to subscriptions and advertising or, in other words, will serve as a business manager. The Canadian Society of Forest Engineers wishes to make the Journal its official organ and it is presumed that the Journal will be furnished to members of that Society at the same price as to members of this Society and to outsiders, namely, at the rate of $3 per annum.

Report of the Committee on Admissions

January 18, 1917.

The Committee on May 15, 1916, issued a list of candidates for membership, including 26 candidates for Active membership, 5 candidates for Associate membership, and 1 candidate for Honorary membership. Of the above candidates 22 were elected to Active, 5 to Associate, and 1 to Honorary membership.

Earle H. Clapp,
Chairman.

The New York Meeting

For the first time in its history, during the week of December 26 to 30, 1916, the Society of American Foresters held a meeting in connection with the Convocation of the American Association for the Advancement of Science, with which the Society is now definitely affiliated.

Owing to the absence of several members who had planned to present papers, there was but one session of the Society, held on Friday, December 29. This was attended by about fifty persons, mostly active members, including representatives of several eastern

States and forest schools, and about five men from Washington. In addition to this, however, a number of foresters spent most of the week in New York and attended the meetings of the Botanical, Ecological, Geographical, and other societies.

The following program of papers was given at the Friday session, which was presided over by Dr. Fernow:

"Forests and Human Progress," by Raphael Zon, F. S. Read in person.

"The Correlation of Forest Research in the United States," by Earle H. Clapp, F. S. Read in person.

"The Biology of Lodgepole Pine as Revealed by the Behavior of Its Seed," by Carlos G. Bates, F. S. Read in person.

"Progress in Administration of University of Missouri's Forests," by Frederick Dunlap, University of Missouri. Read by title.

"The Spread of Timbered Areas in Central Texas," by J. H. Foster, State Forester, Texas. Read by title.

"Reproduction of Black Spruce," by W. H. Kenety, University of Minnesota. Read by title.

"Problems in Forest Pathology," by E. P. Meinecke, U. S. Bureau Plant Industry. Read by title.

"Chemical Examination of Certain American Woods," by A. W. Schorger, Forest Products Laboratory, Forestry Service. Read by title.

"Handling Private Forest Lands on a Basis of Continuous Production as an Immediate Solution to Present Economic Difficulties in the Lumber Industry," by Burt P. Kirkland, University of Washington. The salient points of this paper were given by the chairman.

"A New Classification of the Native Vegetation of the United States into Natural Groups." Accompanied by map. Forest groups described by Raphael Zon, and herbaceous groups by H. L. Shantz, Bureau of Plant Industry.

Messrs. Zon and Shantz presented their map and discussion of plant formations before the Geographical and Ecological Societies, as well as before the foresters. In addition, the following subjects were discussed by foresters before the Ecological Society, all sessions of which were full of the greatest interest for our profession.

"The Basis of Silviculture in the Southern Appalachians," by E. H. Frothingham, Forest Service. Read by S. T. Dana.

"Seeding Habits as a Factor in Competition Between Spruce and Balsam Fir," by Louis S. Murphy, Forestry Service. Read by S. T. Dana.

"Coniferous Reproduction in New England," by Barrington Moore. Read in person.

"Soil Temperatures as a Factor in Forestry," by Raphael Zon. read in person.

"The Effect of Natural and Artificial Shade on Soil Temperatures at Different Depths," by Geo. P. Burns, University of Vermont. Read in person.

"Some Forest Problems in Light," by Raphael Zon. Read in person.

"The Rôle of Light in Natural and Artificial Reforestation," by Carlos G. Bates. Owing to a crowded program this paper was replaced by a few remarks supplementing Mr. Zon's paper.

On Friday evening, a smoker for foresters was given at the Yale Club, at which again nearly fifty foresters listened to an historical sketch of the development of forestry in the United States, given by Dr. Fernow, whose active participation in every phase of the movement is well known. As is customary in Dr. Fernow's writings, neither credit nor criticism was withheld in this instance, but the discussion had the requisite quality of fairness and broadness which distinguishes history from propagandism and politics. Following this warmly received paper, all formality was set aside and the evening was spent sociably.

It is doubtful whether any meeting of the Society of American Foresters during the last eight or ten years has brought together so many professional foresters engaged in different lines of endeavor, and so many who have distinguished themselves, both in teaching and in practice. The stimulus to each individual, from the personal contact and the interchange of views on forestry problems, cannot fail to be of immense benefit. The value to the profession and to the Society of this meeting, in conjunction with the longer-established scientific bodies of the country, can hardly be overemphasized. It must inevitably represent a distinct step forward. As forestry has already established its position as an economic necessity and an integral part of the Government activity for the benefit of all the people, so now we may consider that the most important, if not the first, step has been taken to give a scientific tone to the work, to obtain for

forestry the benefits of research in all scientific lines, and to place before scientists generally the work of foresters and the scientific problems which offer such a wide field for investigation and such promising reward in the way of broad application by Government and other agencies.

Not the least of the results of the New York meeting must be considered the very general demand which was voiced for some means of correlating all lines of forest research and their results. It is understood that as an outgrowth of this demand a Research Committee will shortly be appointed in the Society, to study the needs for correlation, and possibly later to undertake some actual work in this line.

It is planned to publish as many as possible of the New York papers in the second number of Journal of Forestry for 1917. A statement will also be made of the plan for publishing those which for special reasons should appear in other scientific organs.

C. G. Bates.

The San Francisco members of the Society of American Foresters convened on November 11, 1916, for the purpose of forming a Section of the Society. The name of the new Section is California Section of the Society of American Foresters. An executive committee of three, consisting of Messrs. F. E. Olmstead, W. Mulford, and E. P. Meinecke, was elected to draw up the By-Laws and to conduct the affairs of the Section. The first meeting was attended by thirteen members. Raphael Zon read a paper on "Forests and Human Progress," which was followed by a discussion. The second meeting, on December 11, was attended by eighteen members and two guests. Prof. D. T. Mason read a paper entitled "Wanted—A California Forestry Policy." The Section numbers at the present time twenty-one members.

BY-LAWS OF THE CALIFORNIA SECTION OF THE SOCIETY OF AMERICAN FORESTERS

Section 1. The name of this organization shall be the California Section of the Society of American Foresters.

Sec. 2. The membership of the Section shall be open to all members of the Society in good standing and holding residence in California. Members of the Society who reside at points outside of California may also become actively affiliated with the California Section upon written application.

Sec. 3. The officers of the Section shall consist of an executive committee of three, one of whom shall act as the secretary. They shall be elected by plurality vote at the first regular meeting of the Section in the fall of each calendar year and shall serve for a term of one year, or until their successors are elected.

Sec. 4. The secretary shall keep the minutes of the Section, shall conduct its correspondence, shall announce its meetings, shall be custodian of its records, shall collect all moneys due the Section, and shall have the custody of all moneys received.

Sec. 5. The executive committee shall control the expenditure of all funds and shall select the speakers, place and dates for meetings of the Section. Two members shall constitute a quorum of this committee.

Sec. 6. The election of officers or other important business shall be undertaken only at meetings of which all members of the Section have been notified at least three days in advance. At such meetings five members shall constitute a quorum.

Sec. 7. The meetings shall be open to guests introduced by members, except when otherwise stated in the announcement of the secretary.

Sec. 8. There shall be no stated dues. The secretary shall collect by assessment from the members such amounts as the executive committee may find necessary to meet the incidental expenses of the Section.

Sec. 9. These by-laws may be amended by a two-thirds vote of the members present at any meeting.

Mr. M. L. Merritt gave a very interesting talk before the open meeting of the Portland Section of the Society of American Foresters Monday, November 27. His subject was "Personal Experiences of a Forester in the Philippine Islands," illustrated with about 100 lantern slides. The meeting was followed by informal discussion.

Committee on National Defense

At a meeting of the Washington Section of the Society of American Foresters, held at Mr. Pinchot's house on January 25, the chairman of the executive committee was authorized to appoint a committee of inquiry to report on ways and means by which foresters could assist in the national defense. This action was taken prior to the present very acute international crisis and the plan in mind was to be of a permanent nature rather than to meet a present emergency. Recent developments, however, give added point to the contemplated action and, at a meeting of the Section held February 17, the following report of a committee, comprised of Arthur C. Ringland, Chairman, Franklin W. Reed, and Raphael Zon, was approved by the Section and submitted to the executive council for further consideration:

"The committee, believing that democracy imposes an obligation upon all citizens to promote the public welfare and safety at all times to the extent of their ability; that this obligation includes preparation for service in the national defense in case of need; that every profession imposes upon all its members special obligations of service in its peculiar field; that the profession of forestry has always in the United States been proud to recognize the particular obligation to serve first of all the common welfare and has found its main inspiration in the desire to fulfill this duty; and that the field of forestry is one which, in any thoroughgoing plan of preparedness, affords specific and important activities for the profession as a body to assume; desires to recommend and urge that the Society of American Foresters affirm these things as its belief.

The committee believes further that the Society of American Foresters should take immediate steps towards putting into practical effect this belief, as follows:

The executive council of the Society should be urged to take immediate action on the following suggestions:

1. That the entire personnel of the Society, with the exception of the Canadian members, be listed and classified to determine the highest usefulness of each man, either along the lines of his own profession or otherwise, to meet the needs of national defense.

2. That the responsible head of each organization affiliated or association in forestry be officially urged to compile similar data (if it has not already initiated such steps). Such organizations are the U. S. Forest Service, the various State services, the forest schools, and the like. It is here of interest to remark that the U. S. Geological Survey and the U. S. Forest Service have already undertaken such a census of their members.

3. That the responsible heads of these organizations and of the various sections of the Society be officially requested to designate a member to act with and aid the executive council.

4. That these data be compiled and put in useful form at the earliest possible moment, and a special levy made if necessary to cover the cost of such work.

5. That as soon as the data are compiled in usable shape plans be formulated for making it available to the War Department and for assisting and urging individual members to perfect themselves in the qualifications indicated by the classification.

6. That the Society appoint a special committee to confer with the National Council of Defense to the end that suggestions involving the use of forest products needed for military purposes be immediately followed up through investigation, experiment, or otherwise. In this connection attention is called to the need for certain woods for aeroplanes, gun stocks, pontoon bridges, naval stores, material for the manufacture of munitions, and the like.

7. That the National Government be urged to secure full information regarding the extent, location, and accessibility of the forest resources of the country which may have value for special purposes such as those enumerated above, and prepare definite plans which will make possible the prompt utilization of such material in time of war.

8. That the heads of forest schools be urged to emphasize to their students the desirability of taking the military and first-aid courses offered by the universities to which the schools are attached.

At the meeting of February 17 the following resolution was also presented by Mr. Herbert A. Smith and adopted by the Section:

Resolved: That the chairman of the executive committee of the Washington Section of the Society appoint a special committee to receive suggestions and formulate plans looking to the prompt utilization of the services of foresters, in case of need, in whatever way they might be most useful for the national defense.

Resolved: That all members of the Section are urged to transmit to this committee any suggestions which in their individual judgment might appropriately be considered by the committee.

In accordance with the resolution a working committee, consisting of Gifford Pinchot, Chairman, Maj. Geo. P. Ahearn, Herbert A. Smith, Earle H. Clapp, and Arthur C. Ringland, has been appointed to carry out the plan.

CONTENTS

Vol. XV FEBRUARY, 1917 No. 2

JOURNAL OF FORESTRY

OFFICIAL ORGAN OF THE SOCIETY
OF AMERICAN FORESTERS

COMBINING THE PROCEEDINGS OF THE SOCIETY AND THE FORESTRY QUARTERLY

PUBLISHED BY THE
SOCIETY OF AMERICAN FORESTERS
At 930 F STREET N. W.
Washington, D. C.

Single Copies, 50 Cents Annual Subscription, $3.00

Application for entry as second-class matter pending.

JOURNAL OF FORESTRY

A professional journal devoted to all branches of forestry

EDITED BY THE EDITORIAL BOARD OF
THE SOCIETY OF AMERICAN FORESTERS

The Journal appears eight times a year—monthly with the exception of July, August, September, and October.

The pages of the Journal are open to members and non-members of the Society.

Manuscripts intended for publication should be sent to Prof. B. E. Fernow, at the University of Toronto, Toronto, Canada, or to any member of the Editorial Board.

Subscriptions and other business matters may be addressed to the Journal of Forestry, Atlantic Building, 930 F Street N. W. Washington, D. C.

JOURNAL OF FORESTRY

VOL. XV FEBRUARY, 1917 No. 2

THE CORRELATION OF AMERICAN FOREST RESEARCH [redacted][1]

By EARLE H. CLAPP

Assistant Forester, Forest Service

The full development and use of forest lands which comprise at least one-fourth of our total land area in the United States will depend in part upon the policy of the owner whether Federal Government, State, or individual. It will depend in part upon the economic and other conditions which result in the demand for forest products and give them value. Finally, it will depend in no small degree upon the exact knowledge available as a basis for forestry. In a sense, exact knowledge, which can be obtained only through research, influences, or can be made to influence, both policy and economic conditions. The owner will go much further than otherwise when he is sure his undertaking is practicable. With exact knowledge foresters and wood-using industries are equipped with a powerful means of influencing economic changes. Scientific research is therefore at the foundation of permanent forest development in the United States.

That the basic importance of research is being more and more recognized is shown by its initiation by private concerns, by universities, and by States. It was one of the earliest activities of the Federal Forest Service. Yet the field for forest investigations which is still untouched is of such magnitude that the Federal Government and other organizations can not hope for years to come to secure the knowledge which is needed. One reason why better progress has not been made is that all of the agencies now engaged in forest research in the United States are working independently. Far too little is known by any one of the efforts which are being made by the rest.

[1] Delivered at the New York meeting of the Society, December 29, 1916.

But slight attempt, if any, has been made to correlate the efforts of the forest schools, the States, and the Federal Government.

This thoroughly American situation of individualistic rather than coordinated effort, if allowed to continue, will reduce the total investigative output of the country and the possible benefit to the cause. All of our work is now in its early stages. It can be moulded to coordinated effort much more easily now than later. The main question which I wish to place before you today for consideration is whether the time has not arrived for the formulation and adoption of plans which will secure correlation of all the forest research in the United States and cooperation among all the agencies engaged upon it, and which will stimulate to greater efforts those organizations which now are not living up to their responsibilities.

It may be helpful to consider first in a general way the development of the work in the Forest Service, some of the field which has been covered, and some of the more important tendencies. Many of you are familiar with the early work of the Service and the more important changes which have occurred in it to the present. The first considerable activities, beginning about three decades ago, were confined largely to research and forest extension, including popular education. At that time little beyond a partial botanical description and classification of American forest trees had been accomplished. Their life histories had been studied not at all, nothing was known of silviculture or management, and there was little or no demand for knowledge of this character. On the side of forest products there had been developed in the United States a lumber industry of great magnitude, the product of the wilderness conditions under which it operated. The industry, however, had little or no exact knowledge of its product and the consumer was no better off. All was empirical. Early Forest Service investigations attempted to ascertain the properties of American woods and began the studies of the life histories of our most important forest trees.

A natural change occurred in the attitude of Service men toward investigative work when early in the year 1905 the organization was made responsible for the administration of the National Forests. The enormous task of building up an administrative machine, training a personnel, creating new policies adapted to primitive conditions and a new work absorbed the initiative and energies of all the men who could be secured. For a number of years the force of trained foresters

was utterly inadequate to meet the demand. The opportunity for public service in a constructive and urgent work of vast national importance fascinated those fortunate enough to be engaged in it. It was so strong in its appeal that the investigative work for the time became secondary. Forest administration seemed to offer the only real career for foresters. Very soon, however, the real practice of forestry began. It was necessary to raise and plant forest tree seedlings and to develop methods of cutting for many different regions and forest types. The forest must be protected from fire, insects, and fungi. Men began to realize how little real basis they had for their work. Great difficulties were encountered in nursery practice and in field planting. There was uncertainty and great difference of opinion in regard to methods of cutting. European precedents for different species and different conditions, physical and economic, did not adapt themselves readily to National Forest practice. Gradually as the important questions of policy and organization have been settled or greater stability reached, the investigative work has been acquiring the position and the significance which rightly belong to it.

It was realized that in order to secure good results the full time of investigators must be available for research, and that the same men could not successfully carry on administrative and investigative work. Gradually the investigators were separated into distinct units of organization. A central investigative committee considered once a year the entire research program of the Service, correlated the work of the different units, gave it purpose and stability and breadth of vision. Plans of work were required before efforts were started on projects outlining in some detail the method of attack and securing full thought, advice and assistance in advance. Finally research has been recognized as one of the main lines of Service activities and largely set aside in the organization as such. Foresters realize that research offers a career, that those who are fortunate enough to be qualified and are selected for it have an equal or greater opportunity to live in forestry than their associates in administrative work.

The program of the Forest Service has attempted to cover the entire field of forest research. Beginning with dendrology it has led into the life histories of trees and of tree associations or types. All phases of forestation from the production and extraction of the seed to the ultimate results of field planting are under observation. Forest management in its broadest sense is receiving attention. Protection

from fire, insects, and fungi is being investigated either directly or through cooperation with other Federal agencies. Exhaustive studies of the influence of forest upon streamflow are under way. Forest products in the broad sense of the word are being investigated from the tree to the final product or by-product, whether it be lumber or pulp or alcohol or dyes or organic acids. The utilization of the by-products of the forest, such as forage, is covered. Forest economics are studied.

Along dendrological lines the foundation for many other phases of forest investigations is being laid through the description and classification of our trees. In forestation our knowledge has advanced from practically nothing to a point where we are now able to raise and plant the stock of our principal western trees successfully. In a broad way most of the forestation problems of the West have been worked out sufficiently to make planting possible under the most adverse conditions with reasonable assurance of success. Refinements of method, reduction of costs, the solution of here and there a local problem remain. As extremes, planting is now being done successfully on the treeless sandhills of Nebraska, and under the adverse conditions of the Southwest, where nature unaided does not often produce seedlings in quantity more frequently than once in 20 or even 50 years, and only rare combinations of favorable conditions result in extensive natural reproduction. We have underway a study of the relation of forest cover to streamflow, as broad and fundamental in its scope as any which has ever been undertaken in Europe with more centuries of forestry than we have decades. The life history of some 25 of our forest trees has been studied and the results made available for whatever application is possible under present economic conditions. Such studies of individual trees and similar studies of types have largely been preliminary in character, surveys which will afford results for immediate application but permit also a more exact conception of the problems which should be studied more intensively. The study of types, forest ecology if you will, is being more and more recognized as a broader, better solution of our real problems than tree studies, although the tree study is necessary as a first step. Fundamental studies to determine the physical factors which are responsible for type distribution and development have been initiated. In forest management sample plots numbering from 300 to 400 have been established in some cases for more than 15 years, where the

results of the third measurements are now being made available. Many others have been measured a second time. Already these plots are yielding a wealth of information, much of it unforeseen and unexpected, which could have been secured in no other way and which will eventually form the basis of much of our technical practice. In forest mensuration a mass of data has been secured on volume and growth of trees and stands. Pathological and entomological researches are being conducted in other bureaus of the Department. As a basis for fire protection on the National Forests, studies are under way which will permit a more scientific checking of the allotment of funds, on the basis of the values at stake of forest and forage and watershed protection as modified by the possible loss or damage.

Back of all of the forest investigations is the pressure of the administrative organization charged with the running of 160,000,000 acres of National Forests. Waste areas must be planted and methods of seed extraction, of nursery practice, and of field planting made available. The cutting of timber is increasing rapidly and silvicultural methods must be provided. Federal practice must set standards. Under such conditions the investigative program can not be based wholly upon future needs. Present demands must also be heeded. The program must show a balance between pure science and applied, between fundamental research and that which to a reasonable degree will furnish results, perhaps not wholly complete and exact, for immediate practical application. Preliminary surveys such as those already mentioned of the life histories of our forest trees and of forest types must furnish information for immediate forest practice and also outline the problems on which future efforts must be concentrated. Results urgently needed now must be furnished so far as practicable, and at the same time provision must be made for those long-time fundamental studies which alone can produce the final answers. In either case care is taken to see that thoroughgoing scientific methods are employed to make it unnecessary to cover the same ground more than once.

Range investigations have materially contributed to doubling the number of stock grazed on the National Forests during the past 10 years, a result of great immediate economic importance. Regulation of grazing which will permit the use of the forage and simultaneously the production of timber is being perfected.

Investigations of forest products at first anticipated the conscious-

ness of need for them by the industries concerned. The vision of the forester was greater than that of the business man. The wood-producing and wood-using industries were utterly unconscious of how little they knew about their product and the field in which information should be secured. Only during the latter part of the last decade has there been an awakening and this has resulted in part from the serious inroads into the markets for wood by other materials about which there is exact information. The economic need for immediate results has on the whole been far greater in the case of products than in the case of silvical investigations. A similar and greater need exists, therefore, for a judicious balance in our program between pure and applied science, between the fundamental and the technological. In formulating the program for forest products investigations it is necessary to consider something further than the results which can be secured. They are to be used by a series of comparatively primitive industries, industries which have never on their own initiative realized the need for research, industries which are in this respect behind other leading industries in the United States. If by an occasional investigation of a technological character which from the standpoint of research alone might better follow than precede fundamental investigations, the interest and efforts of the industries which are vitally concerned can be stimulated to some degree of self-help the departure would seem to be worth while. In addition such investigations can be made to reduce present enormous wastes of raw material and to increase industrial efficiency.

The program of the Forest Service has included both classes of projects. It has been continuing for years intensive studies into the structure of woods. Studies of mechanical properties were among the earliest undertaken and have been continued regularly. A chemical survey of American woods has been in progress for a number of years. The physical properties of wood are under investigation.

An enormous mass of accurate and detailed data on the mechanical properties of American woods have been secured and their analysis and practical application begun. They have, for instance, formed the basis for the first scientifically drawn grading rules for structural timbers ever adopted in the United States, rules which will again permit wood to compete on a fairly equal basis with steel and other structural materials. Fundamental studies of mechanical properties

have not, however, prevented researches of another character. The American railroads are paying from $30,000,000 to $40,000,000 annually in claims resulting largely from imperfect containers. A few months' work showed that four additional nails at each end of certain kinds of wooden boxes increases by 300 per cent their ability to withstand the punishment ordinarily received in transportation. This result helps also to insure a place for low-grade lumber, one of the crucial points in present-day utilization in many regions.

As I have said, the physical properties of wood are being determined. At the same time these data, as they are secured, are being applied in industrial practice, chiefly in the artificial seasoning of lumber. The way has already been paved for the reduction of industrial losses through improper seasoning running into millions of dollars annually, and also for the successful utilization of species heretofore regarded as of comparatively small value because they could not be dried without great loss.

Although the chemical survey has to the present covered only a comparatively few woods, it has developed methods where there were none, and has already shown its practical value. For instance, in the utilization of spruce for pulp it was found that only about three-fourths of the material suitable for pulp actually appeared in this form at the completion of the manufacturing process. While methods were being developed for a thoroughgoing study of the chemical composition of all American woods, studies were also conducted into the possibility of improving methods of hardwood distillation. It was found that through a very simple temperature control the yield of acetate of lime could be increased commercially by 15 per cent and of alcohol by 30 per cent, and this with practically no increase in operating costs. The improved methods developed have been adopted by a large percentage of the hardwood distillation plants in the Northeast. Improved methods for the production of ethyl alcohol from wood waste promise to permit its manufacture at a cost which will allow competition with that produced from other organic materials. A comparatively simple investigation has demonstrated the possibility of using the dye principle found in the osage orange, and the economic conditions brought about by the European war and the Mexican revolutions have already permitted the development of an entirely new industry aggregating a million dollars

annually in value of product. Practically all of this is from material formerly wasted.

All of the principal pulp-making processes have been or are being exhaustively studied. The suitability for use under the different processes of American woods which occur in sufficient quantities is gradually being tested. Some 20 new woods have been found suitable for ground-wood pulp, 15 for soda pulp, and nearly as many for sulphate pulp. The utilization of bark has been commercially demonstrated for shingle making and its suitability shown experimentally for some grades of paper in which strength is not a requisite. Other discoveries, truly appalling in their simplicity, have been made. By adapting to the sulphate process for the manufacture of kraft paper the ancient housewife's principle that beans should be soaked before they are cooked, and soaking the chipped wood before it is cooked, pulp yields per unit volume of wood have on a semicommercial basis been increased 5 to 10 per cent, cooking time reduced 20 per cent, a saving made in chemicals of about 20 per cent, and the strength of the paper increased 10 to 20 per cent and its quality otherwise improved. American woods not now used have been made into kraft or wrapping paper 50 per cent stronger than any commonly made in the United States or imported.

A series of fundamental studies are under way which will place the entire wood preservation industry on a firm scientific basis chemically and pathologically. In addition, the greatest mass of data available anywhere has already been secured on the effect of various wood preservatives on ties, poles, piling, and other classes of timber subject to decay.

An exhaustive study, country-wide in its scope, of logging and milling costs and methods from the standing tree to the completed lumber product has been under way for several years. It is developing rapidly a more exact basis for the appraisal of National Forest timber and developing the basic data needed by the new profession of logging engineering. In time it will lead into intensive efficiency studies.

In general all technological forest products investigations are first tried out on a small intensive scale. Promising results then pass to semicommercial tests where ordinarily reactions are found to be somewhat different, requiring a corresponding variation in method. No technological investigation is classed as complete, however, regard-

less of its promise, until its feasibility has been demonstrated on a commercial scale. Here reactions show a still greater variation and require greater adaptation to equipment and conditions. Repeated experience has shown that the application of entirely successful experimental results can rarely be made by the practical men of the industries and that they can best be made by the investigator who conducted the original research.

Studies of an economic character have not been neglected. In cooperation with the States much has been done upon the farm woodlot. The problems of the lumber industry in its relation to forestry are now under investigation. Other studies have been undertaken to show the relation of the meat produced upon National Forest ranges to the future supply of the country and of destructive lumbering to community life and development.

The entire experience of the Forest Service in research clearly emphasizes the need for a special force of well-trained men who shall be permitted to devote their entire time and efforts to the work. It emphasizes the need for compactness of organization; for the annual consideration of the program of work as a whole during which the relative importance of all projects under way and proposed will be weighed, progress checked, the entire effort of the organization coordinated, and policies reviewed and if necessary revised; for a program well balanced between pure science and applied. It emphasizes the need for a definite plan of attack on each project before work is begun to secure a maximum of advice and assistance and to reduce lost motion to a minimum, for the annual publication of the program to permit easy reference and analysis and to encourage continuity of purpose and stability.

Results from scientific research in forestry in the United States have by no means been confined to the Federal Forest Service. Private foresters and consulting engineers have contributed. Privately controlled laboratories are working on problems in forest products. Not less than three States are supporting forest products laboratories. A number of forest schools have interested themselves to varying degrees in silvical problems, and products problems as well. One State has a forest experiment station. Not all forest schools, however, and not all States have definitely and clearly provided for research as one of their principal activities. On the whole to one not a member of a

State organization or of a forest school faculty the sum total of effort seems far too small.

Each State has its local problems, many of which it should expect to solve for itself. Has only one State problems of sufficient importance to justify the maintenance of an experiment station? The well-equipped investigator of the future and even of the present must be trained far beyond the requirements of the practitioner. For men so trained all forest organizations must look to the forest schools. Several European countries depend entirely upon the faculties of their forest schools for research. Through the establishment of research organizations the Federal Government and the States have in part relieved the schools of the United States of this burden. But we of the profession still look to them for inspiration and ideals in research as we have in many other things, and for results as well to aid in the full development of forest practice.

Although many and important results have been secured during the last thirty years, and particularly the last ten, the field yet to be covered is larger than it appeared at the beginning. Our work to the present, preliminary in many respects though it may be, has opened vistas for future work of which originally we did not dream. There is hardly a line of work or a region for which one familiar with the problems can not with a few minutes' thought outline important research requiring years to complete. The demand for exact information along many lines will be upon us long before it is ready. It would be far better if the information could be ready in advance of actual demand so that we could direct economic developments into the best channels. The field is enormous. The efforts of all organizations engaged upon forest investigations, under the best conditions of coordination and cooperation, will fall far short of actual needs. At the present, however, there is no correlation and practically no cooperation. So far as I know, the Forest Service is the only organization which goes so far as to issue a list of the investigative projects upon which it is engaged. Except incidentally, we in the Forest Service do not know what investigative work is being conducted by other agencies and only incidentally can any other agency learn what is being done by other forest schools or by other States.

How by any one activity can the Society of American Foresters better fulfill one of the main purposes of its existence than by bringing

about either directly or indirectly, through itself or some other organization, the publication annually or periodically of a statement indicating the projects and their scope upon which each agency or organization will conduct investigations. This I urge as a first step with the hope and belief that it will of itself lead to further measures. The cost of such a publication would be very small. If the data were prepared in accordance with an accepted form the labor involved in its compilation could be reduced to a point where it would not be a burden to busy men.

The second step to be secured more gradually, but as soon and as far as practicable, should be the correlation of the forest research carried on by all agencies in the United States, together with such cooperation as might seem to be desirable and advantageous. Obviously in correlation or cooperation there should be no spirit of compulsion. No organization should be asked to surrender the right to decide finally for itself what it would or would not do. The desired ends could be obtained best through suggestion and a spirit of give and take on the part of all concerned. The object should be to stimulate rather than hamper and retard individual initiative, but to stimulate individual initiative along the most effective lines from the standpoint of the general public good.

The third step should be to bring those organizations which are not sufficiently active in forest research to a full realization of their responsibilities.

I wish especially at this time to call your attention to the need both for deliberation and action before the research activities of the many organizations in the United States become so crystallized that changes would be difficult or impossible.

THE RÔLE OF THE MICROSCOPE IN THE IDENTIFICATION AND CLASSIFICATION OF THE "TIMBERS OF COMMERCE"

By Irving W. Bailey

Bussey Institution for Research in Applied Biology

The problem of distinguishing different kinds of woods, by means of their gross or macroscopic characters, has become progressively more difficult as the number of species in economic use has increased, and as methods for disguising inferior types of woods have been perfected.

In endeavoring to remedy this difficulty, a number of botanists, foresters, and engineers have reached the conclusion that the microscopic characters of wood must be used as a diagnostic criteria in classifying commercial products.

It is a notable fact, however, that anatomical keys for distinguishing woods have not received the recognition and extended use that have commonly been predicted for them. There appear to be a number of reasons why this should be the case, two of which will be discussed in the following pages.

I. LIMITATIONS TO THE USE OF ANATOMICAL KEYS

Owing to their unfamiliarity with the details of the lumber business and methods of grading and handling lumber, most botanists and microscopists have failed to appreciate the fact that there are distinct limitations to the use of minute anatomical characers in classifying and idenifying commercial products.

The average lumberman and tradesman has not the necessary technical information to handle such diagnostic criteria intelligently. Of even greater importance, is the fact that in most cases a large amount of material has to be handled in a limited space of time. This eliminates the use of any except the most obvious anatomical characters.

There are, however, certain important economical fields of usefulness for anatomical keys, in the hands of technical experts, provided these keys are sufficiently accurate and reliable.

In the temperate regions, there are comparatively few species of arborescent plants. The reverse is true of many tropical environments.

With the opening up of the latter sources of supply, many new woods are being offered for sale in the larger markets of the world. If it were possible to trace these woods, by means of an anatomical key, to the botanical species from which they are derived, considerable assistance could be given to lumbermen, not only in the classification of tropical woods, but also in providing them with important information in regard to probable sources of supply, etc.

Another important field of usefulness, for a very accurate and reliable key, should be found in cases of controversy or litigation, *e. g.*, when it is necessary to determine with certainty whether an inferior or undesirable wood has been substituted for a more valuable variety.

II. VARIABILITY OF ANATOMICAL CHARACTERS

Most botanists and microscopists, who have constructed anatomical keys for distinguishing different woods, have assumed that anatomical characters are very constant, and less liable to fluctuate than are gross or macroscopic characters. If not expressly stated, this assumption is implied by the fact that, although the old "rule of thumb" systems of classifying woods, according to their superficial characters, were based upon the study of a very large amount of material, the anatomical keys, that are substituted for them, have been constructed after a comparatively limited number of specimens have been examined.

In view of the fact that, owing to the methods used in their construction, the diagnostic value of most anatomical keys is directly dependent upon the accuracy of this premise, it is essential that special investigations should be made to determine the limits of variability of a number of anatomical characters. That is to say, selected characters should be studies in a wide range of specimens, not only in material from all parts of single trees, but also in wood from plants that have grown under very different environmental conditions.

The writer is gradually bringing together the necessary materials for a number of investigations of this character. Sufficient data have already been accumulated to afford some clue in regard to the variability of a number of anatomical characters that have been used in distinguishing commercial products.

Wood-parenchyma

The distribution of wood-parenchyma has been used by most investigators as a diagnostic criterion in the classification and identification of the wood of Dicotyledons. Sanio,[1] in 1863, distinguished four principal types of distribution. In his "paratracheal" type, the parenchyma is clustered about or jackets the vessels (fig. 5). In his "metatracheal" type (fig. 7), the parenchyma forms tangential bands or concentric layers. The vessels are embedded in these bands, when the latter are of sufficient width, or, when this is not the case, they adjoin them and are jacketed by a layer of parenchymatous cells. In addition to these two types, he distinguished two others, in which the parenchyma is not associated with the vessels. In the first of these, the parenchymatous cells occur in bands or concentric layers. In the second, they are diffused or scattered throughout the wood (fig. 1).

Sanio's four types of parenchyma distribution were subdivided by Krah[2] in 1883. This investigator recognized fifteen distinct types of distribution. In recent years, much emphasis has been placed upon the significance of three of these types of parenchyma distribution in the construction of a natural classification of the higher seed plants.[3] Furthermore, the distribution of parenchyma, owing to its supposed constancy in large groups of plants, has been considered to be the most reliable of all diagnostic criteria in the study of wood.[4]

Certain large natural groups of the Dicotyledons are said to possess "diffuse" parenchyma, a type in which the parenchymatous cells are scattered more or less uniformly throughout the wood (fig. 1). In a second group of families the parenchyma is aggregated about the vessels (fig. 5). This type of parenchyma distribution has been called "vasicentric" and is the same as Sanio's paratracheal type. A third group of families are said to possess wood-parenchyma only at the end of the growth rings (fig. 4). This type has been called "terminal."

The family Rosacæ has been used as an example of a large natural group of plants that possess diffuse parenchyma. This is true of such characteristically north temperate genera as Pyrus, Sorbus, Cratægus,

[1] Sanio, Karl. Vergleichende Untersuchungen über die Zusammensetzung des Holzkorpers. Bot. Zeit., Vol. XXI, No. 50, p. 389, December, 1863.

[2] Krah, F. W. Ueber die Vertheilung der parenchymatischen Elemente im Xylem und Phloem der dicotylen Laubbaume. Berlin, 1883.

[3] Holden, R. Reduction and reversion in the North American Salicales. Ann. Bot., Vol. XXVI, No. CI, p. 170, January, 1912

[4] Forsaith, C. C. Some features in the anatomy of the Malvales. Am. Jour. Bot., Vol. II, No. 5, p. 239, May, 1915.

Amelancher, etc. The distinction breaks down, however, when applied to a number of Rosaceæ that grow outside the north temperate zone. Pygeum, Chrysobalanus, Parinarium, and a number of other tropical or subtropical representatives of the Rosaceæ possess Sanio's metatracheal type of parenchyma distribution. The jacketing of vessels by parenchyma occurs in all of these genera (fig. 2). The parenchyma is, therefore, vasicentric, as well as tangentially banded, and is not entirely diffused among the fiber-tracheids as it is in the north temperate genera previously referred to.

Equally significant is the distribution of parenchyma in the rosaceous genus Prunus. In the northern representatives of this genus the parenchyma is usually scanty or nearly absent in the older wood of the stem (fig. 10). This is not the case, however, in many of the southern representatives of the genus. The evergreen, coreaceous, or schlerophyllous species of the section Laurocrasus, e. g., *Prunus ilicifolia* Walp., *P. sphacrocarpa* Swartz, *P. integrifolia* Sarg., *P. laurocerasus* L., *P. javanica* Miq., and *P. acuminata* Hook., are extremely variable, as far as the distribution of parenchyma is concerned. In certain specimens, the parenchyma is almost entirely aggregated about the vessels (fig. 12), and at the end of the seasonal growth rings (fig. 14). In other specimens of the wood, more or less diffuse parenchyma is also present (fig. 13).

Similar variation in the distribution of wood-parenchyma have been observed in other families of the Dicotyledons. Not only may the distribution of parenchyma be subject, in many cases, to marked variations in large groups of plants, such as orders, families and genera, but fluctuations may occur in a species or variety, and in different parts of a single tree. Such a variation is illustrated in figures 7 and 8. Figure 7 is a photomicrograph of a traverse section of the wood of the mesquite, *Prosopis juliflora* DC. The parenchyma is strikingly metatracheal in its distribution. Figure 8 illustrates the structure of the wood of another specimen of this species. The parenchyma is more nearly paratracheal than metatracheal in its distribution. The first specimen was taken from a tree grown in Arizona, the second from a plant grown in Hawaii.

From this it is evident that the distribution of wood-parenchyma may be extremely constant, or may fluctuate considerably, in any particular group of plants. At the present time there is no *a priori* method of estimating the constancy of this character in a selected

plant or group of plants. Therefore, to be reliable, a key which uses this diagnostic criterion must be based upon a wide range of specimens.

Type and Arrangement of Vessels

The structure and arrangement of vessels, or conducting passageways, have been used extensively as diagnostic criteria in the classification and identification of wood. For example, the patterns, made by this grouping of the vessels, have been used as a means of distinguishing the wood of various species of Ulmus. In the red or slippery elm, *Ulmus fulva* Michx., there are supposed to be several rows of large vessels in the springwood; in the winged elm, *U. alata* Michx., on the contrary, there is supposed to be only a single. row of large vessels in this portion of the growth rings. In the summerwood of the former species, the vessels are said to occur in diagonal or flame-like clusters; but to form tangential or horizontal bands in the winged elm.

That such criteria may be subject to considerable variation, even within a single species, is indicated in figures 3 and 6. Figure 3 illustrates a cross-section of the wood, taken from a "butt" log of the common white elm, *U. americana* L. Figure 4 shows the structure of the wood in a "top" log of the same tree. As the photomicrographs were made at the same magnification, it is obvious that the annual ring was of the same width in both specimens.

In the genus Prunus, the structure and arrangement of the vessels fluctuates much as does the distribution of parenchyma. Figures 10 and 15, cross sections of the wood of *Prunus serotina* Ehrh, illustrate the type of vessel structure that occurs commonly in the northern representatives of the genus. In such tropical species as *P. sphaerocarpa, P. janvanica,* etc., the vessels are usually less numerous, larger and thicker walled, and show a greater tendency to occur in short radial rows (figs. 11 and 12). In many of the sclerophyllous types, such as *P. ilicifolio* and *P. integrifolia* (fig. 9), the vessels are small, very thick-walled and aggregated into larger radial clusters.

It is evident, accordingly, in view of the fact that there is no existing method for accurately estimating their limits of variability in any particular species, that the structure and arrangement of the vessels cannot be used safely as diagnostic criteria in keys that are based upon a limited number of specimens.

Rays

The height, width, and structure of rays have been commonly used by most investigators, who have endeavored to classify the woods of Coniferæ and Dicotyledons. The variations, that are liable to occur in these anatomical characters, may be illustrated by two examples; one taken from the Coniferæ and one from the Dicotyledons.

Figures 16 and 17 are photomicrographs of tangential longitudinal sections of two specimens of redwood, *Sequoia sempervirens* Endl. In the former, the rays are one cell wide, *uniseriate,* a type that is characteristic of most conifers that do not possess horizontal resin passages. In the latter, they are *biseriate* and *triseriate,* types that occur in many Dicotyledons.

As is well known, the wood of the chestnut is commonly distinguished anatomically from that of oak by the structure of the rays. In chestnut, the rays are *uniseriate;* in oak, wide, *multiseriate* rays are present in addition to the narrow sheets of storage tissue. However, it has been found that this distinction breaks down when applied to the oaks and chestnuts of tropical and subtropical regions. Even in our northern species of these genera, the distinction cannot be applied to tissue grown under all environmental conditions. Figure 18 illustrates a cross section of the rootwood of white oak (*Quercus alba* L.). In this specimen the rays are entirely uniseriate. Figure 19 shows the presence of wide rays in the stemwood of *Castanea dentata* (Marsh) Borkh., and illustrates the type of tissue that may be formed by the chestnut when it is attacked by *Endothia parasitica* Mur.

Pits and Tertiary Spiral Thickenings

It will be well, perhaps, to consider the variability of some of the more minute anatomical characters that are only visible under comparatively high magnifications. The form, structure, and distribution of the minute pits which occur in the walls of tracheary and parenchymatous elements have frequently been used as diagnostic criteria.[5] For example, in distinguishing the wood of Taxodium from that of Sequoia, use has been made of the pits between the lateral walls of the ray cells and the adjacent walls of the tracheids. In Taxodium, the elongated orifices of the pits are said to be diagonal to the long axis of the ray cells. In Sequoia, on the contrary, they are

[5] Penhallow, D. P. A manual of the North American Gymnosperms, page 196. Ginn & Co., Boston, 1907.

supposed to be parallel to the axis. However, as is shown in figures 22 and 23, both of these types of orientation occur in Sequoia.

The presence of tertiary spirals, in the tracheids of both the springwood and summerwood, has been considered to be a very characteristic feature of the anatomy of Douglas fir (*Pseudotsuga taxifolia* (Lam) Britton). However, that this character cannot be depended upon invariably, as a diagnostic criterion for distinguishing the wood of Douglas fir, is indicated by figures 19 and 20. As is shown in figure 19, tertiary spiral thickenings may occur in both the springwood and the summerwood of spruce, and, as is indicated in figure 20, these structures may be absent in the tracheids of certain specimens of Douglas fir.

SIGNIFICANCE OF THE VARIABILITY OF ANATOMICAL CHARACTERS IN THE CONSTRUCTION AND USE OF ANATOMICAL KEYS

The preceding examples of the variability of anatomical structures, together with numerous others which cannot be discussed within the limits of this paper, indicate that an unqualified assumption that anatomical characters are extremely constant, is not a safe premise in a search for reliable diagnostic criteria. Furthermore, they suggest that the construction of an accurate and efficient system for distinguishing the increasingly numerous "timbers of commerce," is not such a simple problem as has generally been supposed.

There seems to have been an unfortunate tendency among a number of botanists, foresters, and engineers to fail to recognize, or to ignore, the full significance of the fact that the anatomical structure of wood is not always the same in different parts of a plant, and in different specimens of a species or variety.

Wood is a tissue which functions in conduction, storage and other physiological activities of plants, and varies, therefore, in different parts of a tree, and in different plants, depending upon the variations in the functions that it is called upon to perform.

It is evident, accordingly, that a selected anatomical character, in a given group of plants, may be extremely constant or very variable, depending upon a number of internal (heredity) and external (environment) factors. The inference should not be drawn, however, that all plants growing in similar environments will be structurally similar, since a given physiological effect may be reached by different combinations of anatomical characters. Nor should it be assumed

that similar anatomical structures may not occur in very different environments, for a structure may be held on by factors of heredity, if it is not detrimental to the survival of the species.

In view of these facts, the questions suggest themselves, is it desirable to attempt to use anatomical characters in the construction of a reliable key for the identification and classification of wood, and, if so, what methods should be used in the construction of such a key?

That the former question should be answered in the affirmative is indicated by many considerations. In the first place, the gross or macroscopic characters of wood, such as color, odor, texture, grain, weight, gloss, hardness, strength, resonance, etc., are difficult to describe accurately, and can be easily altered or disguised in manufactured products. As soon as an attempt is made to gauge these characters by accurate qualitative or quantitative methods, they become more cumbersome and difficult to handle than anatomical characters, which can be described accurately and rapidly by means of simple drawings and photographs. In the next place, the gross characters are often much more variable and unreliable as diagnostic criteria than the more minute internal characters. Furthermore, as the number of woods to be classified increases, the construction of an accurate key, such as is needed for general scientific purposes, and the use of technical experts in certain phases of commercial work, becomes so difficult that all available properties, microscopic and macroscopic, physical and chemical, must be made use of.

As has been stated previously, the methods used in the construction of keys for distinguishing different woods have been those of "trial and error." More or less material of each species has been examined, difference between the various species have been recorded and the results tabulated in a key. Owing to the fact that the variability of diagnostic characters has been underestimated, and only a comparatively limited amount of material has been examined, the criteria of one investigator have been found to be more or less unreliable by the next investigator, who has substituted for them characters that he considered to be more conservative. It is obvious that if this process is continued long enough, each succeeding investigator testing the accuracy of the work of his predecessors, a thoroughly accurate and reliable key may be obtained eventually. The progress made at any time will be largely proportional to the amount of material of each species that is examined.

These trial and error methods of constructing keys have certain practical advantages. They are so simple that anyone who has an elementary knowledge of plant anatomy can readily handle them. Furthermore, the keys that are constructed by their use, although not sufficiently accurate and reliable for certain scientific and economic uses, are, nevertheless, of some value in the absence of more dependable systems of identification and classification.

A more direct and scientific method of attacking this problem is to study the limits of variability of anatomical characters in different plants, to endeavor to isolate and analyze the factors which control or regulate this variability, and to attempt to formulate laws for forecasting the behavior of selected characters in any given species. How-

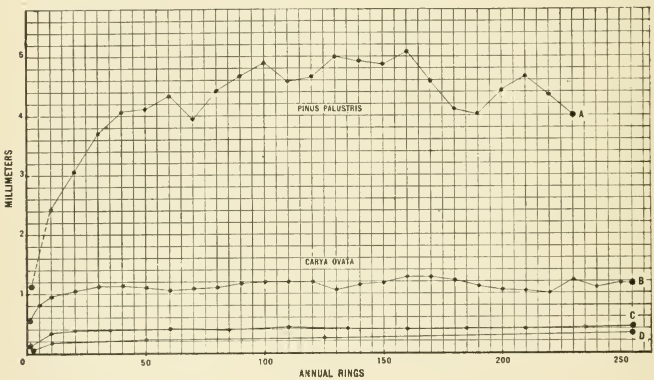


Fig. 24.

Curves showing the variation in size of tracheary elements at different ages of a tree. *A*, Variation in the length of the tracheids in a specimen of longleaf pine. *B*, Variation in the length of the fibers in a specimen of shagbark hickory. *C*, Variation in the length of vessel-segments in this specimen. *D*, Variation in the diameter of the vessels. *A*, after Shepard and Bailey; *B*, *C*, and *D*, after Prichard and Bailey.

ever, the progress that can be made by this method must necessarily be slow, particularly in the beginning, but the results secured should be reliable and accurate. Furthermore, such fundamental and intensive investigations should incidentally throw considerable light upon certain problems connected with the seasoning, pulping, preservative treatment, and chemical utilization of wood.

That the fluctuations which occur in anatomical structures will ultimately be found to conform in a definite and regular manner to the influences of different combinations of internal and external factors, is indicated by data that have been collected by a number of investigators.

For example, the work of Sanio,[6] Shepard and Bailey,[7] and Miss Gerry,[8] and certain data collected by Mr. H. N. Lee at the Canadian Forest Products Laboratory and Mr. W. W. Tupper at the Bussey Institution, indicates that in the development of the stem of arborescent Coniferæ the tracheids increase in size comparatively rapidly for a number of years (see curve A, fig. 24). The duration of this period, and the rate of increase during the period, vary in different

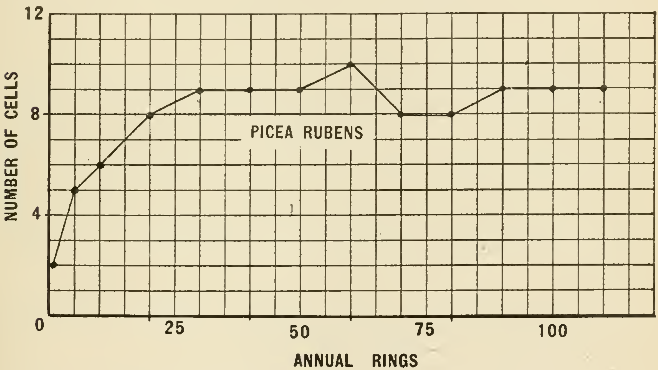


Fig. 25.

Curve showing the variation in the height of the rays in a specimen of red spruce.

plants and in different species, depending upon the effects of various environmental factors. At the end of this period of comparatively rapid increase in size, the tracheid length may remain constant, but usually fluctuates more or less in succeeding growth rings of the tree.

[6] Sanio, Karl. Ueber die Grosse der Holzzellen bei der gemeinen Kiefer (*Pinus silvestris* L.) Jahrb. Wiss. Bot., Vol. VIII, pp. 401–420, 1872.

[7] Shepard, H. B., and Bailey, I. W. Some observations on the variation in length of coniferous fibers. Proc. Soc. Am. Foresters, Vol. IX, No. 4, 1914.

[8] Gerry, Eloise. A comparison of tracheid dimensions in longleaf pine and Douglas fir, with data on the strength and length, mean diameter and thickness of wall of the tracheids. Science, Vol. XLIII, No. 1106, p. 360, 1916.

That somewhat similar conditions prevail in the case of the tracheids, fiber-tracheids, and libriform-fibers of arborescent and large fruiticose Dicotyledons, is indicated by the investigations of Sanio,[9] and Prichard and Bailey[10] (see curve B, fig. 24). Furthermore, the curve in figure 25 suggests that the height of the rays varies in the conifers much as does the size of the tracheary elements.

These curves illustrate, in a diagrammatic and quantitative manner, what has been emphasized earlier in this article, that the anatomical structure of wood is not constant even in different parts of a single tree. Furthermore, it indicates very clearly that diagnostic criteria, secured from a study of herbarium specimens or the wood of small stems, are lakely to prove to be unreliable in classifying and distinguishing the mature wood of large trees.

SUMMARY AND CONCLUSIONS

1. There has been a marked tendency among those who have advocated the use of minute anatomical characters in the classification and identification of wood, on the one hand, to overestimate the possible economic applications of such diagnostic criteria, and, on the other hand, to greatly underestimate the variability of anatomical structures.

2. The fact that the average lumberman and tradesman has to handle a large amount of material in a comparatively limited space of time, eliminates the use of any except the most obvious anatomical characters.

3. There are, however, certain important, although somewhat restricted, economic fields of usefulness for very accurate and reliable keys in the hands of technically trained experts.

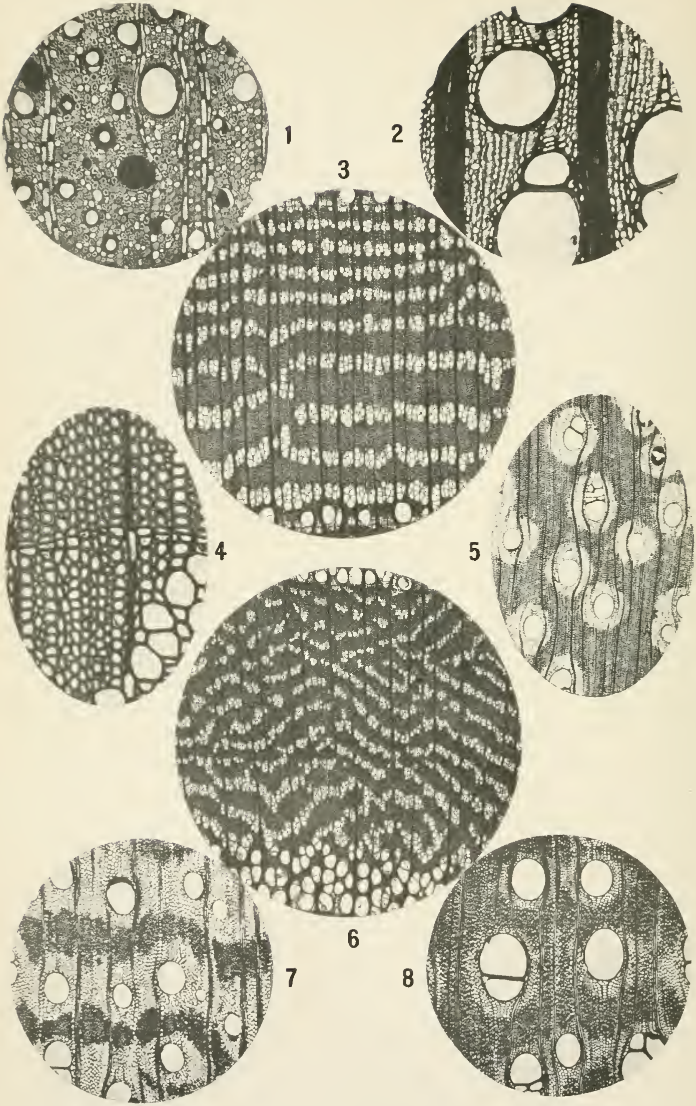
4. The inaccuracies in existing systems of classifying woods are largely due to the fact that investigators have not studied the limits of variability of anatomical characters, but have assumed that their diagnostic criteria are constant and comparatively invariable.

5. A careful study of some of the supposedly more reliable diagnostic criteria, such as the distribution of wood-parenchyma, form and structure of the rays, type of pitting, etc., indicates very clearly that these characters may fluctuate considerably, not only in certain families, genera, and species, but also in different parts of a single tree.

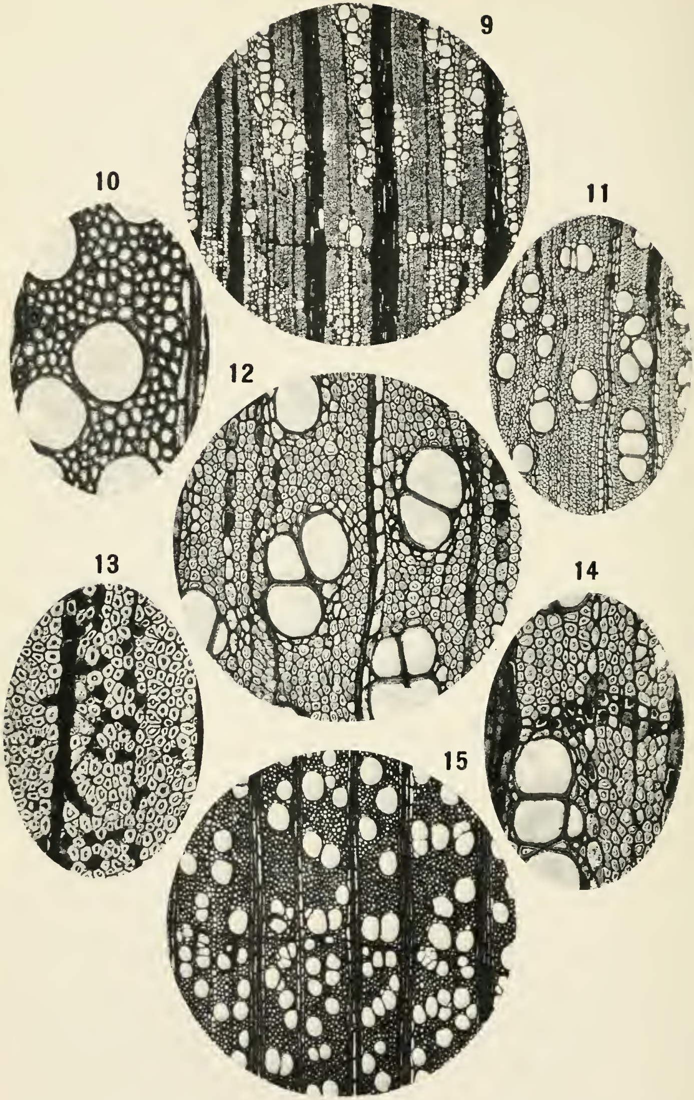
---

[9] Sanio, Karl. Anatomie der gemeinen Kiefer (*Pinus silvestris* L) II. Jahrb. wiss. Bot., Vol. IX, pp. 50–126.

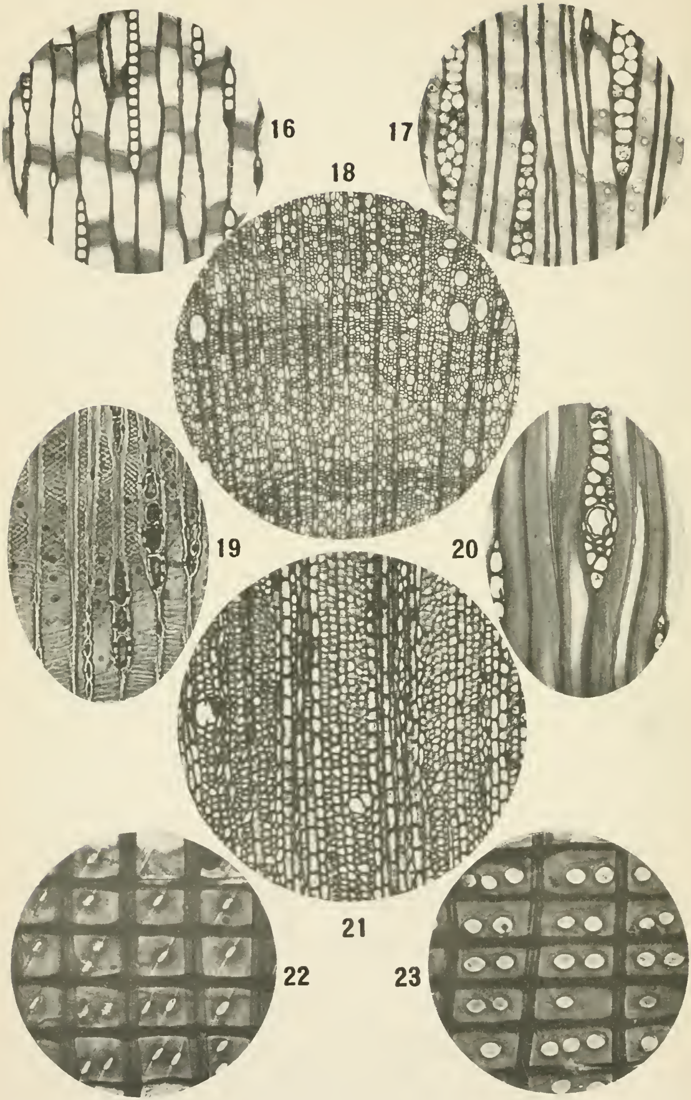
[10] Prichard, R. P., and Bailey, I. W. The significance of certain variations in the anatomical structure of wood. For. Quar. Ined.



BAILEY—IDENTIFICATION OF THE "TIMBERS OF COMMERCE."



BAILEY—IDENTIFICATION OF THE "TIMBERS OF COMMERCE."



BAILEY—IDENTIFICATION OF THE "TIMBERS OF COMMERCE."

EXPLANATION OF PLATES

Plate I

Fig. 1.—*Cercocarpus* sp. Transverse section of the wood, showing "diffuse" parenchyma. X110.

Fig. 2.—*Pygeum Preslii.* Transverse section of the wood, showing "vasicentric' parenchyma. X80.

Fig. 3.—*Ulmus americana.* Transverse section of wood taken from a "butt" log, showing arrangement of vessels. X16.

Fig. 4.—*Osmanthus americanus.* Transverse section of the wood, showing' "terminal" parenchyma. X90.

Fig. 5.—*Dicotyledon.* Transverse section of the wood, showing "paratracheal" parenchyma. X18.

Fig. 6. *Ulmus americana.* Transverse section of wood taken from a "top" log showing arrangement of the vessels. X16.

Fig. 7.—*Prosopis juliflora.* Transverse section of the wood, showing "metatracheal" parenchyma. X45.

Fig. 8.—*Prosopis juliflora.* Transverse section of the wood, showing "paratracheal" parenchyma. X45.

Plate II

Fig. 9.—*Prunus integrifolia.* Transverse section of the wood, showing large rays and vessel arrangement. X45.

Fig. 10.—*Prunus serotina.* Transverse section of the wood, showing absence of parenchyma. X150.

Fig. 11.—*Prunus sphaerocarpa.* Transverse section of the wood, showing arrangement of parenchyma and vessels. X45.

Fig. 12. *The same.* More highly magnified to show parenchyma about vessels. X90.

Fig. 13.—*Prunus integrifolia.* Transverse section of the wood, showing "diffuse" parenchyma. X90.

Fig. 14.—*Prunus sphaerocarpa.* Transverse section of the wood, showing "terminal" band of parenchyma. X90.

Fig. 15.—*Prunus serotina.* Transverse section of the wood, showing rays and arrangement of the vessels. X45.

Plate III

Fig. 16.—*Sequoia sempervirens.* Tangential section of the wood, showing uniseriate rays. X75.

Fig. 17.—*Sequoia sempervirens.* Tangential section of the wood, showing biseriate and triseriate rays. X75.

Fig. 18.—*Quercus alba.* Transverse section of the wood, showing absence of large rays. X35.

Fig. 19.—*Picea* sp. Tangential section of the wood, showing tertiary spiral-thickenings in the tracheids of both early and late formed wood. X180.

Fig. 20.—*Pseudotsuga taxifolia.* Tangential section of the wood, showing absence of spiral-thickenings. X100.

Fig. 21.—*Castanea dentata.* Transverse section of the wood, showing large rays. X130.

Fig. 22.—*Sequoia sempervirens.* Radial section of the wood, showing pits between tracheids and ray cells. X400.

Fig. 23.—*Sequoia sempervirens.* Radial section of the wood from a different specimen, showing pits between tracheids and ray cells. X350.

6. There seems to be little doubt that anatomical characters must be largely dependent upon in the construction of a thoroughly accurate and reliable key, such as is needed for general scientific purposes and the use of technical experts in certain phases of commercial work.

7. There are two methods of constructing such a key. The first is the "trial and error" method of examining more and more material until a key is secured which proves to be accurate and reliable. The second method is logically more direct and scientific. This method of attacking the problem is to study the limits of variability of anatomical characters in different plants, to endeavor to isolate and analyze the factors which control or regulate this variability, and to attempt to formulate laws for forecasting the variability of selected characters in a given species or environment.

8. There are undoubtedly important economic fields of usefulness for the student of plant anatomy in the study of problems connected with the decay, seasoning, preservative treatment, pulping, chemical utilization, and classification and identification of wood, but the business man should realize the fact that the problems to be solved are complex and difficult, and that results of economic value are not likely to be secured without prolonged and painstaking work.

DISCUSSION

Dr. Fernow:

But for the fact that the author has asked me to discuss his paper, I would hardly have ventured to express myself on a subject with which I have not particularly occupied myself for the last 20 years, and then only by directing in a general way the timber physics work of the old Forestry Division. My discussion must therefore take a very general trend, mainly to accentuate the entirely sane position of the author, and to express satisfaction in being able to subscribe unreservedly to the attitude of one who has specialized on the subject. As for that, I could not conceive of any other.

The most convincing proof of the difficulty of using anatomical data for recognition of species came forcibly to my attention during the timber physics work when a competent investigator, who had constructed a wood key based on anatomical characters, found in a lot of samples, carefully collected in the woods and submitted to him, of the four Southern commercial pines, 16 species represented.

We have fortunately arrived at a period in the world's development when the call is general for a scientific basis of our practice. But I fear that our enthusiasm in that direction sometimes slops over and leads us to expect at once more result than it is practically possible to attain. Often much preliminary work needs to be done before we can attack the practical problem directly. Yet practical problems have no time to wait, and hence it is natural that they are solved perhaps not in a scientific and the best way, but out of hand in the best *possible* way for the time, and until a reliable scientific basis is found.

Perhaps the author might have accentuated more strongly the need of keeping the objects of any investigations clearly in view, at least in so far as a distinction can be made into practical issues and scientific basis work.

As regards the practical issue in the construction of a wood key, I would call attention to the fact that the user of wood is much less concerned with botanical relationship of his material than with its quality, and as a rule, it is average quality that he seeks. If there are ten species of white oak which exhibit *practically* the same qualities he is perfectly willing and justified to substitute one for the other. A number of species or even genera furnish the mahogany of the trade, and, in most cases, I take it, satisfactorily. Habit and fashion to a large extent direct the use of wood: the white pine, the king of the woods, found it difficult to be considered in Great Britain in the forties, and in Germany much later. These examples are to serve the purpose of showing that accuracy in botanical determination is to the consumer in many cases irrelevant; quality, which he is accustomed to connect with names, is all he is concerned with. In other cases, to be sure, it is of importance to be able to recognize the species: the difficulty of distinguishing the wood of the Southern pines is a serious handicap, but, as the author hints, a key based on microscopic inspection would hardly satisfy the user; he would be deterred from using it in wholesale inspection.

There is one practical issue, in which an accurate determination is desirable, that interests the forester, more particularly the silviculturist of the future. It is quite certain that the silviculturist of the future will dispense with the many species that nature offers him, and will have to choose among those of similar wood character the ones that

are silviculturally the most satisfactory to handle. In this connection, a key of anatomical characters may prove a great help.

I may add that the author's attitude as regards the great variation of anatomical structures seems unnecessarily pessimistic, as being inimical to key-making. Is this variation really greater than we find in the use of *any* botanical key? Do not such keys represent merely the average of conditions from which the single case may vary widely? The main point is to have examined large numbers in order to strike a reliable average and some knowledge of the amplitude of variation. Whatever the immediate use or usefulness of a key based on anatomical structure, it is proper to continue the detail of such investigations for the eventual use that all scientific discovery is bound to bring.

Professor Roth:

1. Bailey's paper is primarily a statement of facts. They are interesting and useful.

2. Nördlinger in his key of 1881 says in substance: "In answer to the Doubting Thomas who did not believe it possible to distinguish woods by their structure, I published my first table in 1856," etc.

3. Hartig's key was better, but not carefully worked out. Both were ample for ordinary European practice.

4. Bailey is right, but in discussing the use of structure study and keys for the practice he is too modest and too "scientific."

5. The anatomy and histology of wood is interesting and useful in science and in practice; only the latter interests me here.

6. In practice we deal with:

(*a*) Few species or genera which we wish to distinguish in the yard.

(*b*) Locality of growth is usually known.

(*c*) We deal with lumber, or the ordinary log stuff and are not interested in roots and branches, or even stump.

(*d*) We can avoid irregular, apparently abnormal stuff, such as wound wood, extremely fine rings, etc., just as we do not use the lobed leaves of a Linden sprout in identification of linden, etc.

Oak leaves vary more than oak wood in the logs of same tree.

(*e*) In most cases we care nothing about species but are satisfied with *Genus* (spruce, white oaks, hickories, elms, even ash, etc.).

(*f*) In many cases we care nothing even for Genus; Thuga, Chamæcyparis, Cypress.

Our mahoganies are from different genera, but resemble *enough* in structure.

(*g*) Where, as in dye woods, etc., we use barks, roots, etc., it is an expert job to judge and grade, and the practice has long adapted scientific methods here.

7. Study of structure does not pretend to replace the ordinary grading, but to add a more reliable factor.

8. Hand lens examination of white fir by two men *did* cover about 9 *cords* of stuff in one day at Detroit and settled a difference of about $1,000 on a load of pulpwood supposed to be *all spruce*.

9. The most common or extensive use of the study of structure in practice is its value in effective *grading* woods; that is, in appreciating their value for different uses, and understanding their behaviour as to strength, elasticity, toughness, shrinkage, etc.

A man who studied woods in a detailed way will never make the mistake of passing a lot of southern oak, so poor that chair posts broke without any load when the chair tipped over.

10. Sum up: Study of structure and key based on structure *are very useful in practice* and the chief trouble has been thus far that the matter has not been taught and sufficiently published. Such excellent pictures as Bailey's will go a long way to help this. But with it all must come, as he says, full appreciation on the part of writers just how far a particular distinction actually distinguishes. A lot of fine phrases of "annual rings slightly wider" affairs will not help much.

A PRACTICAL METHOD OF PREVENTING THE DAMPING OFF OF CONIFEROUS SEEDLINGS

By Chas. A. Scott

Department of Forestry, Kansas State Experiment Station

A practical method of sterilizing forest nursery seedbeds with high pressure steam to reduce the loss of evergreen seedlings by damping off, has been recently developed at the Kansas State Experiment Station. The investigations have been prosecuted through two seasons of weather conditions very favorable for the development of the damping off fungus, and the efficiency of the treatment has been given a thorough test. The results have been highly satisfactory from every standpoint.

Sterilizing the beds reduced the loss from damping off to an insignificant degree, excepting in the Engelmann spruce beds, while the seedlings of all the species in the unsterilized beds were nearly an entire loss.

Germination was secured two to four days earlier in the sterilized beds than in the untreated beds, and a larger percentage of the seeds germinated in the sterilized beds. In a large nursery this would amount to a big item in the purchase of seed.

Sterilizing the seedbeds destroyed all of the weed seeds and eliminated the cost of weeding. This saving equalled the cost of sterilizing the beds.

The seedlings in the sterilized beds made a more vigorous growth than the seedlings growing in the untreated beds, and at the close of the first season were from two to four times larger than seedlings of the same species grown in the untreated beds.

METHOD OF TREATMENT

The seedbeds in the Kansas State Forest Nursery are 4 by 16 feet and spaced uniformily. The steaming pan is 4′ 4″ by 16′ 4″ by 6″ made of No. 11 gauge boiler iron. The seedbed soil was worked over and thoroughly pulverized to a depth of 8 inches a few days before the beds were sterilized and they were spaded and thoroughly worked over immediately before they were steamed.

The steaming pan was set over the bed in an inverted position, the

edges sunk their full depth into the soil, and weighted down with at least 500 pounds of scrap iron.

The steam was conducted through a one-inch pipe leading from a steam tractor and introduced under the edge of the steaming pan. Loose soil was banked and firmed along the outer edges of the steaming pan to prevent the escape of steam. A pressure of at least 120 pounds of steam was developed before it was turned into the steaming pan and the pressure in the engine gauge was maintained above 100 pounds during the entire period of steaming. The amount of steam admitted into the steaming pan was gauged by the rate at which the soil took it up, the absorption during the early part of the treatment being much faster than during the latter part. The pressure in the boiler was maintained above 100 pounds in order to keep the temperature at the necessary points.

From 35 to 45 minutes' steaming with a pressure of from 120 to 160 pounds in the boiler has given entirely satisfactory results. Under such treatment a temperature of from 94 to 98 degrees Centigrade was secured to a depth of 8 inches in the seedbeds. Such treatment has held in check the damping off of all species of conifers excepting the Engelmann spruce, which has shown little or no benefit from the treatment.

COST OF STERILIZING

The steaming pan cost $35.25, but with reasonable care it should be serviceable for five years or longer. During the spring of 1916, sixteen seedbeds were sterilized, at a cost of $33.45, itemized as follows:

1/5 cost of steaming pan	$7.05
16 hours hire of engineer and engine	16.00
16 hours hire of one laborer at .20	3.20
16 hours hire of two laborers at .22½	7.20
	$33.45

This gives a total cost of $2.09 per bed, which is a reasonable estimate of the cost of weeding an untreated bed throughout the first season. In the fall of 1916, twenty-three beds were steamed at a total cost of $39, no allowance being made for deterioration of the steaming pan.

Four men are required to make an efficient crew, namely, an engineer to fire the engine and keep up the steam, and three laborers to spade up the seedbeds, shift the pan, and attend it during the steaming

operation. An experienced crew of workmen can shift the pan from one bed to another in ten minutes. With the equipment in good working order so that delays do not interfere with the work, it is safe to estimate that one bed can be steamed each hour throughout the day, allowing 45 minutes for actual treatment of each bed.

RESULTS

In the spring of 1916 five beds lying in consecutive order were selected as experimental beds to determine, as far as possible, the amount of steaming required to produce satisfactory results. The ground within these five beds had never before been used for growing evergreen seedlings and was uniform throughout in physical character and fertility, as far as could be determined. Their position in the nursery, according to the regular order of numbering the beds, is 2, 3, 4, 5, and 6. Bed No. 2 was steamed 45 minutes, No. 3, 30 minutes, and No. 4, 15 minutes. The seed sown in these beds was covered with sterilized sand. Bed No. 5 was not steamed, but the seed was covered with sterilized sand, the same as was used in beds 2, 3, and 4. Bed No. 6 was not steamed and the seed was covered with unsterlized sand.

The detailed record of the treatment of these beds is:

Bed No. 2—Steam turned on at 1.05 p. m., and continued until 1.55. A pressure of 130 pounds was maintained throughout the treatment.

Temperature at 1.55 at depth of 3″ was 97° C., at 8″ 94° C.
Temperature at 3.25 at depth of 3″ was 62° C., at 8″ 56° C.
Temperature at 5.20 at depth of 3″ was 46° C., at 8″ 48° C.

Bed No. 3—Steam was turned on at 10.57 and continued until 11.27. The steam gauge showed a pressure of 145 pounds at the beginning of the treatment. This pressure fell to 135 pounds at the close of the treatment.

Temperature at 11.27 a. m. at depth of 3″ was 98° C., at 8″ 98° C.
Temperature at 1.05 a. m. at depth of 3″ was 60° C., at 8″ 68° C.
Temperature at 3.05 a. m. at depth of 3″ was 51° C., at 8″ 44° C.
Temperature at 5.25 a. m. at depth of 3″ was 48° C., at 8″ 40° C.

Bed No. 4—Steam was turned on at 10.35 a. m. and continued until 10.50, with a pressure of 160 pounds at the beginning of the treatment which fell to 130 pounds during the run.

Temperature at 10.50 a. m. at depth of 3″ was 97° C., at 8″ 62° C.
Temperature at 1.10 p. m. at depth of 3″ was 54° C., at 8″ 46° C.
Temperature at 3.05 p. m. at depth of 3″ was 42° C., at 8″ 38° C.
Temperature at 5.30 p. m. at depth of 3″ was 28° C., at 8″ 29° C.

FIG. 1.—The steaming pan used at the Kansas State Experiment Station in sterilizing seedbeds, in position for use and weighted down with scrap iron. Note steam pipe at left hand side, through which steam is conducted from the traction engine.

FIG. 2.—Jack pine seedlings, showing the relative size of the seedlings that grew in each of the experimental beds. The lower row of seedlings are individuals taken from the groups in the upper row. The cord indicates the approximate ground line.

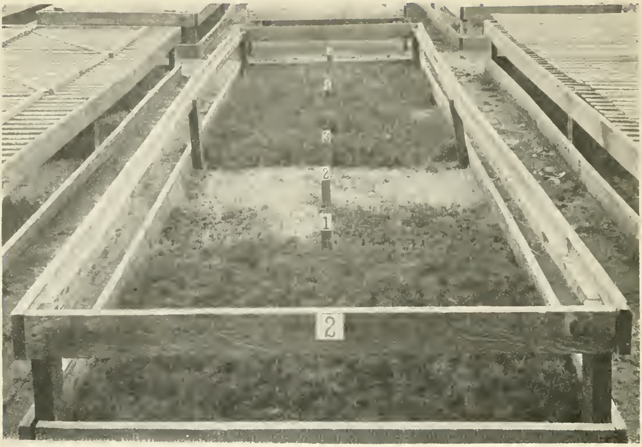


FIG. 1.—This bed was steamed for 45 minutes. A temperature of 97° C. was secured at 3 inches below the surface and 94° C. at 8 inches below the surface. The seedlings in the foreground in section No. 1 are jack pine, average stand being 200 seedlings per square foot. Those in section 2 are Norway spruce; average stand per square foot, 284¾. Those in section 3 are Black Hills spruce; average stand per square foot, 84. Those in section 4 are Austrian pine; average stand per square foot, 122. Those in section 5 are western yellow pine; average stand per square foot, 101.

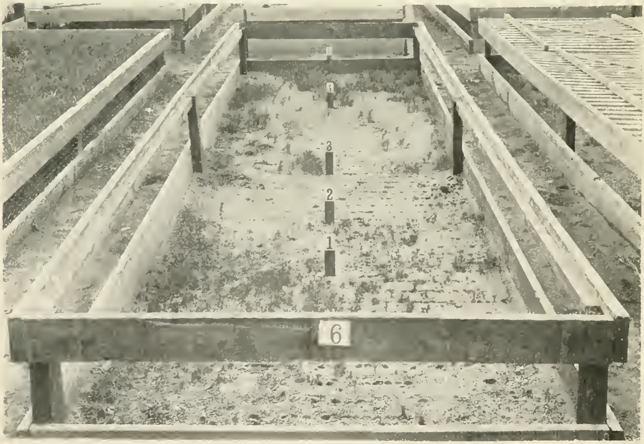


FIG. 2.—The bed contains natural soil. Neither the seedbed soil nor the sand covering the seed was sterilized. The seedlings in the foreground in section 1 are: Jack pine, average number per square foot, 45¼; in section 2, Norway spruce, 52 1/5 per square foot; in section 3, Black Hills spruce seedlings, all damped-off; in section 4, Austrian pine, 6 seedlings per square foot: in section 5, yellow pine, 17¼ per square foot.

In thoroughly pulverized soil the temperatures at given depths are practically uniform throughout. If the soil is not physically uniform the temperature secured will vary considerably, as hard lumps are not readily penetrated. Hence it is necessary to have the soil thoroughly pulverized before treatment is given.

An equal area in each of these beds was sown to jack pine, Norway spruce, Black Hills (Engelmann) spruce, Austrian pine and western yellow pine. An equal amount of seed of each species was sown in each bed. At the end of the growing season, October 5, a full count of all seedlings in each bed gave the average number of seedlings per square foot as follows:

Number of Seedling per Square Foot.

	Species				
	Jack Pine	*Norway Spruce*	*Black Hills Spruce*	*Austrian Pine*	*Western Yellow Pine*
Bed No. 2 steamed 45 minutes..	200	284¾	84	122	101
Bed No. 3 steamed 30 minutes..	181¾	371½	101	72	88¾
Bed No. 4 steamed 15 minutes..	146¼	279½	13¼	102¾	71
Bed No. 5 not steamed, seed covered with sterilized sand...	12¾	32	00	1¾	27
Bed No. 6 not steamed, seed covered with sand not sterilized	45¼	52½	00	6	17¼

The greatest number of seedlings of each species must be considered a normal stand. The number of seeds sown per square foot was not ascertained by count. An equal quantity of the three species of pines was sown on an equal area, 16 square feet in each bed. One-half the quantity of each of the species of spruce was sown on eight square feet in each bed. As the seed of the jack pine is much smaller than that of the Austrian or western yellow pines, a large number were sown. The seeds of the spruces are much smaller than those of the jack pine. Probably the number of seeds of the spruce, sown per unit area of seedbed was fully double the number of seed sown of the jack pine.

The different beds were given the same care and treatment throughout except for the differences mentioned.

The seed in the unsterilized beds, numbers 5 and 6, were from two to four days slower in germinating than the seeds in the sterilized beds. From the time the seeds germinated the seedlings in the sterilized beds made a more vigorous and thrifty growth than the seedlings in the unsterilized beds. At the close of the growing season the seedlings of the three species of pines in the sterilized beds were from two

times to four times larger than the same species grown in the unsterilized beds.

The only weeds that appeared throughout the season in the sterilized beds came from the seeds carried in by the wind after the beds were sterilized. These were mostly dandelion and cotton-wood seedlings. There were not enough of these, however, to make an item in the cost of growing the seedlings. The unsterilized beds were weeded six times. The costs of weeding the unsterilized beds fully equaled the cost of the sterilizing treatment.

ARRANGEMENT OF SEEDBEDS

A convenient arrangement of the seedbeds in the nursery will greatly reduce the cost of sterilizing the beds.

In the nursery at the Kansas State Experiment Station, any of the beds can be reached from the central alley with a run of 32 feet of pipe with a joint in the middle allowing a free swing at the elbow.

Beds 4 by 16 feet have been found to be a very convenient size. Sterilizing smaller beds would be more expensive as it would take the same length of time to sterilize a smaller bed as it does for one of this size. Larger beds would be impractical because of the difficulty with which a larger pan could be transferred from one bed to another.

Low frames are used throughout. When the beds are being sterilized, the frames are set aside or stacked, as is most convenient.

NOTE.—The illustrations in this article are used through the courtesy of the Kansas State Experiment Station.

MANNAN CONTENT OF THE GYMNOSPERMS

By A. W. Schorger

Chemist in Forest Products, Forest Products Laboratory

A marked difference between the conifers (*Gymnospermae*) and hardwoods *(Angiospermae)* occurs not only in the structure but also in the chemical composition of the wood. In a previous communication[1] it was pointed out that water soluble galactans occurred in many of the conifers. The present paper has a special bearing on the relative amounts of mannan present in the various species.

So far as is known, carbohydrates yielding mannose on hydrolysis have been found in only one hardwood. Fromherz[2] obtained mannose from *Populus tremula* L. The lignocellulose purified by treatment with acid and alkali was heated with water in an autoclave at 150 degrees. The aqueous solution after boiling with sulphuric acid was found to contain mannose. The writer, employing hydrolysis at atmospheric pressure, examined six species of hardwoods, among them *Populus tremuloides* Michx., but in no case was mannose detected.

The presence of mannans in various woods has been shown by several investigators. Tollens[3] and associates found mannose in sulphite liquor, the raw material generally employed being *Picea excelsa* Lk. The presence of mannan in the wood of about a dozen conifers was shown by Bertrand[4] who also made several quantitative determinations. Kimoto[5] found 6.35 per cent mannan in *Cryptomeria Japonica* Don. A study of several American species was made by Storer[6] but only two quantitative determinations were reported; the mannose hydrazone was identified microscopically.

Bertrand[7] considers the source of the mannose from wood as a mannocellulose. This classification is not justified on account of the ease of hydrolysis of the parent carbohydrate, the latter falling properly into the class of hemicelluloses created by Schulze.

The presence of mannan in woods is of technical significance. According to Schwalbe[8] waste sulphite liquors may be considered to contain sufficient fermentable sugar to give 60 liters of ethyl alcohol per "tonne" (2,200 pounds) of pulp, which is equivalent to 108 pounds of alcohol per ton (2,000 pounds) of dry pulp. On the basis of a

[1] Schorger and Smith, Jour. Ind. Eng. Chem., 8 (1916), 499.
[2] Zeit. Physiol. Chem., 50 (1906), 237.
[3] Ber. 23 (1890), 2990; Zeit. Ang. Chem. 5 (1892), 155; Ann. 267 (1892), 349.
[4] Compt. Rend., 129 (1899), 1027.
[5] Bull. Coll. Agr. Tokio., 5 (1902), 254.
[6] Bull. Bussey Inst., 3 (1902), 32.
[7] Compt. Rend., 129 (1899), 1025.
[8] Zeit. Ang. Chem., 23 (1910), 1540.

yield of 45 per cent of pulp, about 2.5 per cent of the dry wood is recovered as alcohol. The results obtained by Krause[9] show that mannose constitutes about 60 per cent of the total fermentable sugars in sulphite liquor. The various woods examined contain sufficient mannan alone to furnish 2 to 4 per cent alcohol so that considerable mannose is evidently destroyed during the cooking process. It is plain, however, that mannan must be considered the chief source of the ethyl alcohol.

By the hydrolysis of white spruce Kressman[10] obtained 6.8 to 8.3 per cent of absolute alcohol. This species contains 7.12 per cent mannan from which it is theoretically possible to obtain 3.5 per cent alcohol. It is difficult, however, from available data to determine how much alcohol is derived from the mannose. Mannose[11] is apparently as stable when heated with acids as dextrose, but it is probable that considerable mannose is destroyed during the cooking since all the mannan would be hydrolyzed at the beginning of the reaction. Yeasts that ferment dextrose will usually ferment mannose equally well, but exceptions occur.

EXPERIMENTAL

The method of determining mannan was the following: The wood cut into sawdust was so ground as to pass through a 40-mesh sieve. A portion was removed for determining moisture. Ten grams of the fine material with 150 c.c. of hydrochloric acid sp. gr. 1.025 were placed in an Erlenmeyer flask connected with a reflux condenser and boiled 3½ hours. The contents were then filtered into a 500 c.c. flask, and the sawdust washed back into the Erlenmeyer with about 100 c.c. of distilled water. The sawdust was then digested a short time over a Bunsen burner, and again filtered. This method of extraction was continued until the total filtrate amounted to 500 c.c. The solution was then transferred to an 800 c.c. beaker, neutralized with 10 per cent NaOH, rendered slightly acid with acetic acid, and evaporated on the steam bath over night to 150 c.c. The solution was again filtered to remove humus matter, the filter being washed with a little cold water. A mixture of 10 c.c. of phenylhydrazine and 20 c.c. of water, rendered acid with glacial acetic acid, was added to the filtrate contained in a 200 c.c. Erlenmeyer. The flask with frequent shaking was allowed to stand two hours. The precipitate of mannose phenylhydrazone was collected in a weighed alundum or Gooch crucible washed with cold water, then with acetone to remove resinous im-

[9] Chem. Ind., 29 (1901), 217.
[10] Jour. Ind. Eng. Chem., 7 (1915), 920.
[11] Fischer and Hirschberger Ber., 22 (1889), 365.

purities, dried and weighed. The mannan content was calculated from the weight of the mannose phenylhydrazone by multiplying by the factor 0.6. The yields are based on dry wood, the moisture having been determined in an air oven at 105 degrees.

The cream-colored mannose hydrazone was dissolved in hot 75 per cent alcohol and filtered, using a suction pump. The filtrate usually becomes opaque at once from the separation of microcrystals of the hydrazone. Three crystallizations usually gave practically colorless crystals. The melting point of the various hydrazones varied from 188 to 190 degrees by slow heating.

The results obtained are given in Table 1. The wood in all cases was taken from the trunk of the tree and unless otherwise stated the sample represents a radical section containing both heartwood and sapwood. The sample descriptions, where possible, are given in some detail, since future work may show that the mannan content is dependent on such factors as the age of the tree, season and locality.

Duplicate determinations of the mannan content usually did not differ more than 0.3 to 0.4 per cent, but occasionally differences as high as 1 per cent were observed. To determine if all the mannan had been hydrolyzed the sawdust from limber pine heartwood and longleaf pine sapwood was air-dried after the first hydrolysis. This was again boiled with fresh acid and treated in the customary manner. Since the alundum crucibles increased in weight but 0.003 and 0.004 g. respectively, there was practically a quantitative removal of the mannan in one hydrolysis.

TABLE 1.—*Mannan Content of Various Conifers*

No.	Species	Mannan	Description
		Per cent	
1	Douglas fir (*Pseudotsuga taxifolia* Briton)	6.65	Cut in May; Washington.
2	Corkbark fir (*Abies arizonica* Merr.)	6.57	May; 4 ft. up; 6 in. diameter. Arizona.
3[a]	Western larch (*Larix occidentalis* Nutt.)	5.13	Montana.
4	Arborbitae (*Thuja occidentalis* L.)	1.44	Wisconsin.
5	White spruce (*Picea canadensis* Mill.)	7.12	November; 12 ft. up; 13 in. diameter. Wisconsin.
6	Longleaf pine (*Pinus palustris* Mill.)	4.75	May. Florida.
7	Longleaf pine (*Pinus palustris* Mill.)	1.64	July; sapling 6 yrs. old; 1.5 ft. up; 2 in. diam.; Mississippi.
8	Loblolly pine (*Pinus taeda* Linn.)	5.10	May; Florida.

[a] Extracted with hot water to remove galactan previous to hydrolysis.

TABLE 1—Continued

No.	Species	Mannan	Description
9[b]	Cuban pine (*Pinus heterophylla* Ell.)	5.81	(*a*) Heartwood; Tree 18 in. in diameter, 8 in being sapwood.
		9.22	(*b*) Sapwood; May; Florida.
10	Sugar pine (*Pinus lambertiana* Dougl.)	4.67	Heartwood; California.
11	Coulter pine (*Pinus coulteri* Lamb.)	5.22	June; 20 yrs. old; 5 ft. up; 13.5 in. diam. California.
12	Coulter pine (*Pinus coulteri* Lamb.)		Tree cut in June; 30 ft. up; 19 in. diam.
		5.40	(*a*) Heartwood; 8 in. diam.; 19 years old.
		6.28	(*b*) Sapwood; 62 years old. California.
13	Monterey pine (*Pinus radiate* Don.)	7.68	February; 10 ft. up; 17.5 in. diam; 35 years old. California.
14	Piñon pine (*Pinus edulis* Engelm.)	6.00	May; 1 ft. up; 10 in. diam. Slow growth. New Mexico.
15	California swamp pine (*Pinus muricata* Don.)	3.07	June; 12 ft. up; 7.5 in. diameter; 12 years old.
16	Chihuahua pine (*Pinus chichuahua* Engelm.)	5.00	May; 3 ft. up; 5 in. diam.; 38 years old. New Mexico.
17	Western white pine (*Pinus monticola* Dougl.)	6.93	June; 18 ft. up; 15 in. diam.; 230 years old. Montana.
18	Western white pine (*Pinus monticola* Dougl.)		June; 34 ft. up; 16 in. diameter.
		7.13	(*a*) Heartwood; 13 in. diameter.
		7.44	(*b*) Sapwood; Montana.
19	Whitebark pine (*Pinus albicaulis* Engl.)	4.22	June; 3 ft. up; 10.5 in. diameter, 2 in. being sapwood; 130 years old. Montana.
20	Western yellow pine (*Pinus ponderosa scopulorum*)	4.64	May; 2 ft. up; 15 in. diameter; 110 years old. "Black jack" variety; Arizona.
21	Jeffrey pine (*Pinus jeffreyi*)	5.40	Sapwood; June; 2.5 ft. up; California.
22	Digger pine (*Pinus sabiniana* Dougl.)	7.17	June; 14 ft. up; 9 in. diameter, one-half being heartwood; 70 years old; California.
23	Limber pine (*Pinus flexilis* James)	5.94	Heartwood; May; 10 ft. up; tree 8 in. diam.
24	Bristlecone pine (*Pinus aristata* Engelm.)	5.41	May; 10 ft. up; 6 in. diam.; 5 in. being heartwood. Colorado.
25	Knobcone pine (*Pinus attenuata* Lemm.)	3.57	June; 3 ft. up; 8.5 in. diam.; 47 years old. California.
26	Basswood (*Tilia americana* L.)	0.00	November; Wisconsin.
27	Sugar maple (*Acer saccharum* Marsh)	0.00	December; Michigan.
28	Yellow birch (*Betula lutea* Michx.)	0.00	November; Wisconsin.
29	Green ash (*Fraxinus lanceolata* Borkh.)	0.00	November; Missouri.
30	White ash (*Fraxinus americana* L.)	0.00	
31	Aspen (*Populus tremuloides* Michx)	0.00	New Mexico.

[b] Heartwood contained 10.4 per cent resin that was removed by extraction with ether previous to hydrolysis. The mannan content of the dry resin free heartwood would be 6.54 per cent.

A longleaf pine tree 120 years old and 53 feet tall was felled in Mississippi in July. Small disks were cut from the trunk at the distances 2, 22, and 45 feet respectively from the ground, and their mannan content determined as follows:

TABLE 2.—*Mannan content of a longleaf pine* (*Pinus palustris*)

Disk		Heartwood		Sapwood	
No.	Diameter	Mannan	Diameter	Mannan	Diameter
	Inches	*Per cent*	*Inches*	*Per cent*	*Inches*
1	8.25	4.85	3.50	5.14	4.75
2	6.00	3.02	2.75	4.03	3.25
3	2.75	....	....	3.07[a]	....

[a] For entire disk, heartwood and sapwood being indistinguishable.

The results obtained indicate that there is more mannan in the sapwood than in the heartwood, and that the mannan decreases progressively from the base of the tree upwards.

A radial section of a sugar pine log having a diameter of nearly four feet was divided into six parts and analyzed to determine if the mannan content varied appreciably from the center of the tree to the circumference. The results are given in Figure 1. The mannan

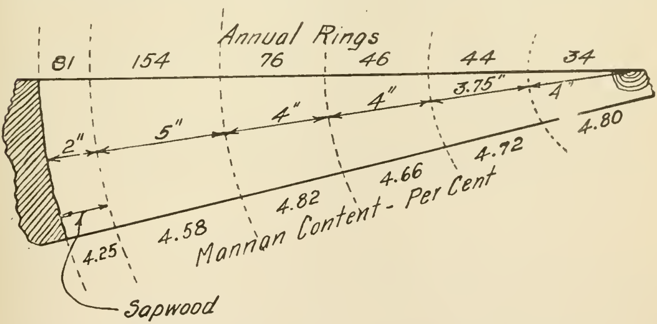


FIG. 1.—MANNAN CONTENT OF RADIAL SECTION OF SUGAR PINE.

is uniformly distributed throughout the heartwood but decreases in the sapwood. The figure for the sapwood is the result of three determinations. This is the only exception observed to the general rule that the sapwood contains more mannan than the heartwood. This generalization is supported by the results from samples Nos. 9, 12, and 18, Table 1, and disks Nos. 1 and 2, Table 2. This suggests the possibility of obtaining considerably larger yields of ethyl alcohol from slabs and edgings than from mill-run sawdust.

According to Fischer[12] when 0.1 g. of mannose hydrazone is dissolved in 1 c.c. of concentrated cold hydrochloric acid, 5 c.c. of water immediately added, and the solution examined in the polariscope using a 1 dcm. tube, the d-compound gives a rotation of 1.2° to the left. The crude mannose phenylhydrazone obtained from *Pinus lambertiana* was recrystallized three times from dilute alcohol. Two different samples of the hydrazone purified in this way, using the proportions given by Fischer, had the rotations —0.657° and —0.796°. Lindsey and Tollens[13] found —0.761° for the mannose hydrazone obtained from sulphite liquor.

A portion of the practically colorless hydrazone was heated with phenylhydrazine acetate in aqueous solution for 1.5 hours on the steam bath. The yellow osazone obtained, after recrystallization from 60 per cent alcohol, melted at 203-4°.

A sugar solution obtained by the hydrolysis of white spruce was treated with phenylhydrazine acetate in the manner described above and allowed to stand over night. The hydrazone obtained was so very impure that a quantitative estimation of mannose was impossible. The hydrazone was dissolved in 75 per cent alcohol, the solution filtered, and allowed to crystallize. After these operations had been repeated four times the crystals melted at 186-8°.

It is proposed to extend this investigation to other species and determine if the amount of mannan in a given tree actually varies throughout the year. The statement of Czapek[14] that mannans always belong to the reserve hemicelluloses requires confirmation. It is very questionable if the mannans, especially those occurring in the heartwood of trees, can be considered as reserve food materials.

SUMMARY

1. The results of the examination of 22 different species of Gymnosperms and 6 species of Angiosperms show that mannan is present in appreciable quantities in all the conifers but is absent from the hardwoods.

2. It appears that the mannan content of the sapwood is generally larger than that of the heartwood; mannan decreases from the base upwards but remains uniform throughout the heartwood in a radial direction.

3. Mannan is of industrial importance in the production of ethyl alcohol from sulphite liquor and by the hydrolysis of sawdust with catalyzers.

[12] Ber., 23 (1890), 384.
[13] Ann., 267 (1892), 350.
[14] "Biochemic der Pflanzen" Zweite Auflage., 657.

FOREST BIOLOGY

By P. S. Lovejoy

Assistant Professor of Forestry, University of Michigan

About fifty years ago there were some billions of feet of good tamarack standing on some millions of acres through the Lake States and the Northeast. The tamarack saw-fly has practically eliminated the species as a forest tree. The insect is a native and there is no reason to suppose but that it was present and did more or less damage to the tamarack for untold years. But it increased tremendously within a decade or so and the tamarack seems to have been eliminated from commercial consideration throughout its eastern range. It is known to attack Larix of several species and no Larix is known to be at all immune. Perhaps it will appear before long in the Montana-Idaho country and repeat its performance on the western larch. Perhaps it is at present in the Rockies. Is there any species of Larix that can be considered at all safe in America? It is a very valuable species. Its loss is a serious matter.

Through all the western yellow pine region, the great majority of "over-mature" trees are actually killed by the work of Dendroctonus, even though they might be expected to succumb from other causes within a few years if the insect did not make its attack. About twenty years ago, in the Black Hills, the Dendroctonus became unusually active. It attacked not only the very old and injured individuals, but spread generally through the stand, killing practically everything from the small pole stage up, even though it seemed to "show a preference" for the older trees. Of late years this heavy infestion has appeared to be stationary or to be on the decrease. Hundreds of millions of feet of good pine has been killed and large areas have been practically denuded. In many other regions the beetle is very active and is sufficiently damaging to have warranted large expenditures in its attempted control. In still other places, where stumpage values or the character of the stands do not warrant it, the beetle is at work unchecked. New areas of infestion are reported annually. The future of the exclusively yellow-pine Black Hills forest is certainly in doubt. If the Black Hills experience is to be duplicated in other pure western yellow pine stands, or if the conditions now reported are to be accepted as "normal," is a forest of this species of pine a safe forest?

The gypsy and brown-tailed moths were accidentally loosed in our eastern forests. Millions have been expended in attempts at their control, with only fair success. Both insects annually appear in extended ranges and their extinction seems beyond any reasonable hope, even if their "control" be proven practicable. Would one care to invest heavily in forest property in the moth area?

The chestnut-blight fungus seems to have been imported from Asia, though some question as to this seems to have been raised among mycologists. If the organism should prove to be a native species on a rampage, the situation would be more complex than otherwise, but, in any case its damage is still on the increase and there seems to be little if any hope for the chestnut in America. As a commercial forest species it seems to have become out of the question. In a varigated forest mixture the chestnut was by far the most valuable species and its loss is a most serious affair.

The black locust has a rather limited native range. In its native range it is attacked by the locust-borer, but in spite of this many individual trees and even whole stands make fair development. Where the locust is planted out of its original ranges it often makes a splendid growth. Its technical value is very high, or rather would be high if it were not for the borer. But the borer seems to be worse in exotic plantations than on the native ranges. In spite of the wide adaptability of the locust, as a forest tree, it is today of very little importance because of its persistent enemy. There seems to be no reason to anticipate any improvement in its status.

We have with us the white-pine blister rust, undoubtedly a European importation. Within the year the number and range of infected areas has been reported as largely increased, in spite of vigorous and early measures toward its control. In view of our experience with the chestnut-blight, and considering the method of fungus propagation and spore distribution, would a well-informed forester care to prophesy the eradication of the disease in America, our ability to keep it restricted, or our ability to prevent reinfection by accidental (or otherwise) importation? Would one even care to estimate the probable rate of its spread? If these are doubtful matters, what as to the economic future of white pine? In parts of Europe it has been given up as hopeless.

Within the last two years, certain Lake States plantations of white pine have been seriously attacked by a species of saw-fly, which

behaves with the pine as its sister species does with the tamarack. The inspect species seems to have been known before, but there seems to be no previous record of its having done any considerable damage. The infestèd plantations have been hand-picked and sprayed without regard to expense, and the pest may be "under control"—or may even be "eradicated"—or it may appear in new localities and on larger timber which cannot be sprayed. Then what?

Considerable areas in the East, which once raised good white pine, are now so badly infested with a tip weevil that practically every specimen of the tree is dwarfed or stunted, and plantations of this kind are no longer considered. Will the weevil extend its range? If so, how rapidly?

A Dendroctonus, in the western white pine of the Inland Empire, behaves toward its host species much as does the species which attacks the western yellow pine. Old and decadent individuals are "normally" killed by it, but here and there, and over vast areas, heavy stands of mature pine are being killed off. Once started on a considerable scale, it is the rule that practically every pine in the stand, large or small, is killed before the infestation "runs out." One may stand on the divide of many a valley and count the "red-top" spots by the dozen. Investigation will show that some of the dying timber is white pine, some Douglas fir, some Englemann spruce, some lodgepole pine, each, presumably (but not always certainly) being attacked by its own variety of Dendroctonus. The local assumption is that the amount of dying timber is rapidly on the increase. It is certainly serious. Since standing "bug-killed" white pine depreciates very seriously within two years after being killed, on account of season checks and bluing, there is a small margin of salvage time. The wise investor might well hesitate before he bought bonds secured by white pine in a vicinity where the beetles are at work, especially where the timber is inaccessible and cannot well be logged out for many years.

Cypress and incense cedar are famous for their characteristic decays. They are both intrinsically good species. But would it be advisable to attempt extensive and expensive forest work with them as a major item in the stand? Would proper handling secure utilization before the typical defects developed very far, or would it be possible to prevent the work of the fungi or to "keep them under control?"

Trametes pini is responsible for the bulk of the defective and un-

merchantable timber in lodgepole and white pine. There are very large areas where the majority of the large trees are wholly unmerchantable because of its "white" or "red rot." It is also bad in Englemann spruce.

Echinodontium tinctorum in western hemlock and white fir is a typical nuisance, a growing expense as stumpage values in this species increase, and, for the future, something of a menace.

The amount and value of the standing white oak each year rendered unmerchantable by round and flat headed borers may well equal the amount of this species that reaches the market.

Southern pine logs must be rushed from the woods to the mill and the dry-kiln or the chemical bath in order to prevent the lowering of grades caused by the "bluing" fungi (or is it fungus?).

Every coniferous nursery in the country and probably in the world suffers from the work of the "damping-off" fungi (known, in this case, to be plural).

The collection of Douglas fir and other cones, in some seasons and localities, is not worth the while because of the work of seed-destroying insects. Where these insects have not been at work and the seed is sound, the moulding of the green cones in the sacks largely increases the expense of opening them and probably impairs the quality of the seed.

The gnawing of mountain-rats and brush-rabbits has practically prohibited the planting of large areas of California chaparral country.

Rabbits, in certain large districts in Canada, are causing more damage than fire and appear to be a more permanent menace to the local spruce forests.

A considerable section of a rich Montana valley is practically depopulated and forest work in the vicinity is more or less at a standstill on account of an especially virulent fever transmitted to humans by a wood-tick.

Natural reproduction and artificial plantation of white pine in many of the Adirondack Parks is at present useless because of the continual browsing of the deer.

Broadcast sowing of tree seed in the burns of the western mountains would be the cheapest and perhaps the most satisfactory method of reproducing those millions of acres, were it not for the difficulty of ridding the planting areas of rodents, principally chipmunks and mice, which eat the seed which has been broadcasted and even that put in by the seed-spot method.

Certain successful western plantations, just beginning to make good leaders, have been more or less ruined by grouse picking off the terminal buds.

Greyling in the AuSable River of Michigan and big rainbow trout in the North Platte in Wyoming, have become scarce since the rivers have been driven.

The bighorn sheep of the Rockies are practically extinct, presumably because the scab disease of domestic sheep was communicated to them.

In proportion to their total values, the damage done to the fish and fur and game by forest fires is probably greater than the damage which the fire does to the timber.

Trees and other plants may become pests in the forest, as in the extending chaparral areas or perhaps in the case of the jack pine and scrub oak of the Lake States sand plains, or like ailanthus in various sections of the Middle States. Poison ivy and sumac and the poison range plants of the West are forest associates. The ravages of the mistletoe in the South and West are just beginning to be appreciated as serious and promising to be difficult of control. In the South the water hyacinth often interferes with log transport; green briar increases the cost of lower Mississippi logging. Various species of Ceanothus, the buckthorn, menzezia sala, vine maple, and sweet fern are forest pests. Successful control of the black-locust borer seems to be predicted on the elimination of golden rod from the vicinity of plantations. The eradication of Ribes from white-pine stands may be imperative if white pine is to be protected from the blister rust. Many forests can be worked efficiently only when the mosquito and the black fly and the "punkie," the rattlesnake and the chigger and the woodtick are no longer present or are tremendously reduced in numbers.

Through the administration of grazing affairs, in the western forests, the forester is intimately concerned with the contagious diseases of domestic animals. Failure to cooperate with the proper authorities effectively may let loose on his forest a band of sheep with the lip and leg disease and this may drive out the other sheep permittees, losing the income for the season. In the South any forest administration will have to cooperate with the anti-tick campaign among cattle owners.

Another phase of forest administration appears in the necessity for exercising supervision over the sanitation of camps, especially

in the prevention of water contamination. A variation of this item is found in the desirability of preventing the destruction of fishing through the dumping of mill or mine waste into the streams.

In the Lake States, considerable portions of the forest reserves are now producing little save a huckleberry crop, but this is eagerly utilized by the local population, which assumes that constant burning over of the berry patches will improve the crops. As with the light-burners of California and the Gulf States, the forester is directly and sometimes desperately concerned.

If the site is poor and dry, it may be that the debris of cutting should be lopped and scattered. The presence of such material sets up a large fire risk, the importance of which is dependent upon the rapidity with which the wood-destroying fungi do their work. If any of these saprophytes are facultatively parasitic, their unusual development on the brush may result seriously for the remaining stand.

The Pacific Coast Douglas fir stands originated after severe fires. With fires kept out for a rotation or so, the accumulation of litter and humus so changes the site that the fir drops out and its place is taken by hemlock and abies, which become progressively poorer as the humus and litter grow deeper and more acid.

Lodgepole pine stands, almost without exception, have been burned over repeatedly. Humus and litter in these forests is practically wanting. In many cases, where fire has not run for some time, reproduction is of balsam and spruce. What may be expected in lodgepole if fires are kept out for a few rotations?

Trametes pini does very widespread and severe damage in lodgepole, causing the red and white rots which so lower the scale of many cuttings. It forms sporophores very seldom, if ever, in the pine, but fruits heavily on the Englemann spruce scattered through the stand. On the assumptions that it does not fruit on the pine and does not spread by rhizomorphs, there is no danger in leaving badly infected unmerchantable trees of lodgepole on the cutting areas, but it may be imperative to prohibit the spruce in mixture or, failing this, it might be necessary to lower the pine rotation by many years.

It often happens that windfall or cutting or fires expose a stand of eastern hemlock to strong side light. A species of "parch blight" develops and the hemlocks on the edge of the opening die, exposing those behind them, which die in turn, eventually killing a great amount of good timber.

In the Puget Sound and Coeur d'Alene regions, fire hazards differ in the stands very largely in proportion as the different species tend to accumulate lichens and moss. The moss formations, when dry, are exceedingly inflammable and scatter fire to long distances with little wind.

According to Darwin's famous reasoning, the crop of clover seed was in inverse proportion to the percentage of blue-eyed cats in the neighborhood. Bees were necessary to carry the pollen which fertilized the seed. Mice, if too numerous, would destroy the bees. Cats would keep the mice down. Blue-eyed cats had defective vision and could not be good mousers.

The usual conception of a forest is that of a host of trees of various species and ages, contending more or less with each other and against climatic conditions, but, on the whole, simply a lot of plants growing along together. Such a conception is very seriously in error, for a forest is no such thing. A forest is one of the most complex of societies. In point of total population per unit of area, a forest is one of the most densely inhabited areas in the world, numbering its inhabitants by the billion per acre. As respects variety of inhabitants, the forest also ranks very high—higher than the farm, the orchard, the city, the prairie, perhaps the swamp. Certain water areas may exceed the forest in both number and variety of inhabitants, but the forest includes a great variety of types of fresh-water formations and frequently the water-societies are intimately associated with those of the forest or man's work in the forest.

The inter-relations of the different forms of life and their inter-actions and inter-dependencies are certainly intricate beyond the possibility of present imagination. We know very little indeed about biology, therefore little about the forests; but we are beginning to be able to form some conceptions of the situation, and it is already obvious that Darwin selected a simple category.

To the uninitiated, would there appear to be any probable relation between an experiment in silk worms, automobiles, New England forests, and real estate values? Would there appear a menace to our most valuable tree species because of cheap labor and favorable soil and weather conditions in Holland and the presence of wild goose-berries and currant bushes scattered throughout the white-pine forests? Would one be likely to assume that the fecundity and travel habits of innocuous rodents might increase the cost of reestablishing

forests on burned acres by five hundred per cent? Of that the passing passion of a landscape architect for exotic decorative plants might precipitate a national calamity? Or that a few days of extra cold weather in mid-winter might save a billion or so feet of good spruce and its owners some millions of dollars?

Mrs. O'Leary's cow is reputed to have spilled a pail of milk with her left hind foot and burned Chicago. It may well be that the superintendent's decision to open a new level in the Homestead Mine in September brought about the killing and waste of several hundred million feet of Black Hills timber and that this finally gave a pocket full of railroad passes to a mycologist, and because of this that the practice of wood-impregnation in America was measurably advanced, so that the loss of the Black Hills timber may ultimately prove to have been a boon. The forest is a very complex affair and the forester has need of being a very well-trained and exceedingly wise man. His real troubles have hardly yet begun and a test tube with a cotton stopper or the pink-legged larvæ of a bug even yet unknown to the Bureau of Entomology may prove his best friends. Such things do not of necessity detract from the interest of the forester in his work.

If the cotton crop begins to fail because some bug is eating up the bolls, an entomologist will identify the insect and then proceed to give it a name and work out its origin and its life history. By the time he has finished this the entomologist may have some notions as to what may be done to control the new pest. In all probability, however, that entomologist will now be transferred to other entomological work and experts in agriculture, having now detailed and dependable information concerning the insect, will begin to experiment with control measures. When they have established practicable measures and eliminated impractical ones, in all probability they will be transferred to other work and the job of getting farmers to diversify their crops will be turned over to a practiced publicity man with a smattering of agricultural knowledge and an easy way with editors and politicians and storekeepers and bankers.

When the chestnut-blight fungus began to work it was unnoticed for several years. Then some one called the attention of a mycologist to the dying trees. The mycologist examined the fungus and gave it a name. Other mycologists became interested and gave it other names. Some mycologists said that it was a native species which for more or less intelligible reasons had run amuck, while others

offered evidence that the fungus must have come from China via Japanese dwarf chestnuts. A battery of mycologists went to work on the organism's life history and rapidly discovered and drew pictures of a variety of spores. In the meantime farmers were losing their woodlots and estates their famous shade trees. Nobody could well do anything until the methods of spore distribution were worked out. Since the spores could be carried by insects and birds and everything which moved through the infected forests, entomologists and Biological Survey specialists became involved in the activities. It was considered possible that infected trees might be induced to take up toxins which would kill the attacking fungus or make the tree immune. Plant physiologists were called in to experiment with toxins and therapeutic agencies. Still the disease spread. Numbers of young foresters and others were sent into the woods to superintend the cutting and burning of the diseased material. Other foresters worked up data to indicate the seriousness of the situation and set to work to devise means to utilize the dead timber, so as to prevent as much waste as possible. The others have done their work, and we know now what the fungus is and how it works and some of the ways in which it may be possible to control it. The application of possible control measures and determination as to their economic feasibility and general practicability must be left to the forester.

The typhoid organism may have been discovered by a bacteriologist. Physicians may have worked out its life history and have developed the fact that the fly is the common carrier. Entomologists may now review the life history of the fly. Everything has now been done save the development by experts in prophylaxis of an effective serum to confer immunity against typhoid—and the stopping of the fever among the people. When things have reached their proper stage, sanitary measures will be enforced by the town constable, and the milk and water inspectors. Neither the constable nor the inspectors can do work unless they fully understand what it is all about. They will not be experts in bacteriology, entomology, or prophylaxis, but they can nevertheless do the work if properly directed by a good health officer.

In the aggregate, during the last twenty years or so, a very great amount of work in forest entomology, mycology, biology, and physiology has been done by specialists in those things. In many cases these specialists have discovered an organism, named it, and more or

less sketched its life history. Sometimes they have devised or proposed methods of combating it. In spite of all this, the fact remains that, up to the present, little more than a few poorly conducted experiments in control work have been carried on and these, not infrequently, with indifferent success. For this situation there are several good reasons.

In many cases the work done by the specialists is in most miserable shape for use. Items and fractions of information have been rushed into print here and there and never properly assembled. The specialist can readily run down existing data with his card-indexes, but the rest of us cannot.

Very frequently the specialist has not completed his work, having failed to determine such essential items as the enemies of his particular pest or the viability of spores. The very common disinclination of specialists in a given line to use a uniform method of reporting further clouds the situation.

Often the specialist, having written up something of a life history and having suggested one or more methods of control, considers that he can have no further interest in the matter since he has now covered the scientific field and all that can remain is for the interested parties to follow out his suggestions and find relief. Not infrequently the suggested control measures are out of the question on economic grounds. Concerning such grounds the specialist can have little judgment. Other control measures that are perhaps practical may be devised.

If a logger is losing timber from the attack of a bark-beetle it may not be helpful to him to learn that he can kill the beetles if he will locate all infested trees in August and in September burn the tops over the stumps and soak the logs in water for a week. The logger is not apt to try all that, even if it is the only known treatment which will be effective. Somebody must be prepared to undertake the location of the trees and the cutting and barking and burning. He must be able to take a cruise through the woods, rough up some estimate as to the numbers of infested trees, check up on identities, verify the essentials of life history, estimate costs and plan a crew and a layout and explain it all to the logger. When the logger protests that he cannot move a few logs from here and there to water for a week's soaking, he must be told that barking will do as well. If the logger still protests against the costs, such matters as the rate of deterioration of peeled logs in the woods, stumpage values, annual

rate of losses in feet, board measure., etc., must be explained to him in his own language. In that way, perhaps, there is hope of getting action. Whether he knows it or not, the specialist is out of his field when it comes to woods work. It is the forester's field. The forester begins where the specialist leaves off; he must be the mordant between the purely "scientific" and the purely "practical." The "practical" man, as shown by experience in a hundred lines of work, cannot utilize the production of the "scientist" directly. Usually he cannot even understand the language in which the technical man must write. There must always be a go-between—some one sufficiently technical to understand and be able to use and criticise and experiment with the purely technical and work it over into practicability, or, if the technical is already practicable, to prove it in the field and introduce the new idea in such a way as to get something done. Until very recently, there have been so few foresters available that no one has gotten very far with actual control work.

Another potent reason for this condition lies in the fact that the bulk of our foresters have, so far, been covered up with administrative and executive work and with the simpler forest investigations required by the work at hand. Still another reason may lie in the fact that it is only within, say, five years, that American foresters in general have waked up to what they have on their hands in the way of pests and diseases. That we are arriving is principally due to the rapidity with which our forests are being covered by surveys. For the first time we can form a notion of what we have and the condition that it is in.

Still another reason may well be mentioned. The bulk of our foresters in high administrative positions were early graduates from the forestry schools or had no technical education. The early schools taught but little concerning forest biology because there was but little known about the biological status of our forests—and because the early student could not be persuaded that such fancy stuff was of any considerable importance. More or less this difficulty still persists, owing to the difficulty of the students appreciating the necessity of grounding in the essentials before taking up the purely forest aspects of the several sciences involved, and, perhaps also, the instructors have not always acquired the point of view of the forester.

In a medical school it is unlikely that bacteriology will be taught by an instructor without a degree in medicine or in a school

of engineering that applied mechanics will be taught by other than an engineer. Both subjects may be well commanded by specialists who are not physicians or engineers, but the point of view brought to the teaching by the man who is first the physician and afterwards a bacteriologist is more and more essential. It will undoubtedly be so in forestry, and there is already a marked tendency in this direction.

A similar evolution is perceptible in the field. More and more there is a demand for forest pathologists instead of mycologists and entomologists. Some recent work done by such men is particularly notable. It is to be urgently hoped that more good men will specialize and become available to foresters.

But the fact remains, and must always remain, that the forester is the man in charge of the forest and the man who must decide what shall be done, when and where it shall be done, and what it may cost. It is the farmer himself who must practice diversified farming to escape the boll-weevil pest, the orchardist who must spray for moth and scab and scale, the physician who must fight the plagues. Each must draw freely from the specialists in his line, but each must do his work alone. This is particularly true in the case of the forester, with his great areas and long working periods. To the forest the forester must always be *in loco parentis*. The parent watches and wards for a child and a good parent is much of very many things. And still the parent calls upon the physician, the dentist, the druggist, the oculist, or the other specialists, freely and at need—and is glad of the chance to do so. But a hospital would be a poor place for a child to be reared, and a surgeon might make a poor playmate. To the forest the forester is *in loco parentis*. He cannot delegate his duties if he would. The good forester must be much of many things, for he is dealing with one of the most complex of societies.

BASIC PROBLEMS IN FOREST PATHOLOGY

By Dr. E. P. Meinecke

Forest Pathologist, Bureau of Plant Industry

Forest pathology deals with all factors causing loss in forest trees, either in actual or prospective timber values. The more abnormal the forest, the broader the field of forest pathology. Its problems are intimately interwoven with the conversion of virgin abnormal forests into regulated forests approaching the normal. It would have no place in the hypothetical normal forest.

The normal forest is distinctly an Old World concept of the ideal forest, producing continuously a maximum of timber under given conditions, allowance being made only for unavoidable loss. At the time when the concept of the normal forest began to take more definite shape, only the most conspicuous forms of damage to the forest, such as insect calamities and timber rot in general were known. Long before all the innumerable factors making for loss in the forest began to be studied, the timber-producing forests of the Old World were under management; that is, approaching the ideal of the normal forest. Frequent thinnings and a short rotation worked, to a certain degree, for sanitation and hygiene. Management incidentally reduced a good deal of the avoidable loss, so much so that, in spite of the admirable research work of men like Willkomm and Robert Hartig, until more recently there seemed to exist no necessity for a conscious and concerted effort to control this loss, and that the idea of factors making for loss other than those governed by cultured methods hardly entered the concept of the normal forest.

In America we have, of course, taken our concepts from European forestry and in all theoretical discussions the ideal normal forest remains the pivotal point, as though we already were well on our way towards regulation. In practical forestry outside of the relatively small managed forests of the East, we have to do exclusively with virgin forests, and here the practically attainable is, at least for many years to come, so singularly out of proportion to the ideal that the concept of the normal forest, except as a very remote goal, can only create confusion.

The difference is but one of point of view. The European forester

is so well advanced on the road towards an ideal clearly in sight, that only those inevitable accidents which we call the factors of unavoidable loss, should be able to prevent him from reaching the end. He has no longer an excuse for neglecting avoidable loss. The American forester is standing at the beginning of the trail, and dim is the light, indeed, which guides his faltering steps in a general direction towards an apparently unattainable ideal. His starting point is the virgin forest, in which so far no injurious factor is controlled on a larger scale, except that of fire. Locally insects have been kept in check and on the relatively small-sales areas on the National Forests the introduction of the sanitation clause, where applied, has eliminated certain tree diseases. Rarely has it been possible to influence the type by favoring species best adapted to the physical factors of their surroundings, and individual treatment of stands or trees through thinning or pruning is still out of the question.

Such intensive forestry cannot be expected at the present time of the large timber owner, and the administration of the National Forests must keep within the limits prescribed by legislation. Obviously, this condition of affairs cannot last. The time will—and must necessarily—come when our virgin forests, at least the typically timber-producing, accessible parts of them, will be brought under a management whose chief aim is an assured supply of timber on the basis of a sustained annual yield, timber meaning not maximum volume only, but maximum volume of sound and high grade lumber. In other words, the forests of the future will be grown under conditions in which the avoidable loss from physical as well as biological factors is reduced to a minimum. It is plain that even an attempt at such a control of avoidable loss is impossible without a thorough knowledge of the behavior of the tree, the stand and the forest with regard to controllable factors. Our present knowledge of these factors themselves is very limited, much more so our understanding of the economic rôle they are playing in the forest. Hardly half a century has elapsed since the birth of modern silviculture, forest pathology, and forest botany in general, and we still have to admit that we are standing at the very threshold, that our understanding of the intricate life of the forest is not sufficient to apply it directly to the problems of the virgin forest. It is idle to predict the exact time at which American forestry, in special American silviculture, will be able to turn from a more negative, day to day policy to positive, constructive

activity. It can not come until far-sighted legislation has paved the way. Until then, all we can, and must do, if we have any sense of statesmanship, if we believe in the future of forestry, is with all our energy to prepare for the coming work, to put our earnest research to the service of the future forest, to avoid as best we can any unnecessary injury to the legitimate interests of generations still unborn. There is no time to be lost.

Meanwhile the American forester is called upon to properly utilize the immense stores of timber on virgin forests in Government or private ownership. Two diametrically opposed practices have developed. One, based on immediate returns, concerns itself little, if at all, about the future of the area cut off. Its aim is, with least cost, to turn into cash the accumulated growth of centuries, and it considers cull in the broadest sense of the word, as unavoidable loss. The other, more conservative system, as practiced by the Government, while undoubtedly making as full use as possible of its timber, is ever mindful of the constructive side of forestry. Conscious of its duties to the present generation arising from its position as the largest individual timber owner of the nation, the Government can not overlook the fact that every act as well as every omission must of necessity have its bearing, beneficial or injurious, on the forest of tomorrow. The times of opportunism, of makeshift policies, has passed long ago. We live in a period of deliberate and conscious planning, of formulating a definite and far-sighted program for the future.

This program, aiming at the slow, gradual conversion of the virgin forest into regulated forests, while utilizing to the full the present stock of timber, can not but take into account the nature of the virgin forest, which forms the very antithesis to the normal. It must consider risk of loss in standing timber from decay, windfall, lightning, insects, etc., as cumulative[1] and shape its policies in such a manner as to minimize this loss as much as possible. Obviously, only part of the loss is really unavoidable, the rest is avoidable if only we know the casual factors and learn to control them. Silviculture will look to forest pathology for the solution of these problems, and unless forest pathology is satisfied with being one of the many specialized branches of general plant pathology, it will have to grasp this golden opportunity and deliberately adopt the forester's point of view. The

[1] Meinecke, E. P. "Forest Pathology in Forest Regulation." U. S. Dept. Agr., Bull. No. 275, Professional Paper, p. 9.

one great forest pathologist the world has produced so far, Robert Hartig, possessed this view in a remarkable degree. But Hartig's field was the regulated forest of Europe, in which many of the avoidable factors of loss had already been eliminated as a matter of routine, and where costly control measures are often remunerative on account of the intrinsically high value of the timber. In American forests, with their immeasurably more complex problems, forest pathology has until recently more or less duplicated Hartig's work as far as pure description is concerned. The first necessary step, quite logically, was to take an inventory of our forest diseases and to study them from a purely botanical point of view. This line of work is far from being complete. It is fundamental in character and its value cannot be overrated. But it is botany, mycology, plant pathology rather than forest pathology. It concentrates its interest on the ætiology of a given disease, the description of the casual factor and the effect on the individual rather than on the relative importance of the disease with regard to possible loss and the bearing on the productiveness of the forest, present and future. So far there exists no standard by which to gauge the relative importance of a given disease; in fact, the perusal of most of the contemporaneous literature on forest tree diseases leaves one with the impression that all of them are more or less of equal importance. Obviously that cannot be the case. There are numerous diseases interesting from a botanical point of view no doubt, which are negligible in the life of the tree or the forest. A line must be drawn somewhere. Only a rational system of rating can bring order into this chaos.

The relative importance of a disease or of any cause of loss in the forest is governed by a number of factors, of which the economic value of the species affected, the character of the injury, and the aggressiveness of the agency causing loss, are beyond doubt the most important. The economic valuation is influenced largely by the representation, range and accessibility of the species affected. Aggressiveness is judged by the virulence of the attack, the liability to spread over the entire range of the species irrespective of topographical and climatological influences, and the faculty of attacking other species in admixture.

To illustrate: The well-known chestnut-bark disease which has swept through the East during recent years doing untold damage, fairly threatens to exterminate *Castanea dentata*. This tree is one of

the most highly prized broadleaf species of the East and is heavily represented in the States east of the Mississippi. The values involved reach many millions of dollars. In its native habitat, China, the same disease does scant damage to Chinese chestnut trees which are of little value. Of low virulence on Chinese chestnut, it is exceedingly aggressive in the eastern chestnut forests. The relative importance of the disease with regard to economic values threatened, to representation of species and to aggressiveness, must, therefore, be given a very high rating in the United States, but a very low one in China. On the other hand, the trees are killed but not destroyed by the disease. The character of the damage cannot be considered to be nearly as serious as that done by wood-destroying fungi, since evidently the economic values of a tree are not represented by its living organs but by the lumber it contains. The menace to the lumber contained in trees killed by the chestnut-bark disease does not come from *Endothia parasitica,* the cause of the disease, but from secondary, wood-destroying fungi and insects. The killed trees can be utilized if cut in time. It is only when the killing takes on such proportions as to make immediate utilization impossible that the ultimate effect is the same as though the timber were lost through heartwood-destroying fungi. In a general rating as to the relative importance of the chestnut-bark disease this point must be taken into account.

Another example: *Polyporus sulphureus* in the Sierra Nevada causes a very common and destructive heartrot of red fir (*Abies magnifica*). It generally appears in the butt of the older trees, which finally break off in heavy storms. But *Abies magnifica* grows only at high elevations from about 6,000 to 8,000 feet, forming large stands, of which but few are accessible. At lower elevations the fungus seems to be confined to oaks of very little value. The relative lumber value of *Abies magnifica* is not high; it ranks somewhat better than *Abies concolor.* The relative importance of *Polyporus sulphureus* in stands of *Abies magnifica* must be given a low rating in spite of the fact that it does destroy very large quantities of lumber. In the same stands *Polyporus sulphureus* occasionally appears on *Pinus lambertiana,* the most valuable of the pines of the Pacific Coast. But this pine is distinctly outside of its range in the red-fir belt. It is weakly represented and the disease seems to be so rare on this species that in spite of the intrinsic value of *Pinus lambertiana* but a low rating can be given to *Polyporus sulphureus* in this case.

Polyporus amarus, the cause of the very common dry rot or pin rot of incense cedar, follows this species throughout its range and is responsible for the marked, if not wholly justifiable, depreciation of this otherwise valuable timber. The fungus is very aggressive, but it is strictly confined to incense cedar and constitutes no danger whatever to the other associated timber species.

Certain agencies causing loss would in themselves be given a lower rating if they were not linked with others of greater importance. Leaving actual killing out of discussion, the damage done to older trees by fire consists generally in more or less deep burns through which an easily determined amount of timber is mechanically destroyed. Once the fire has stopped, the injury has reached its maximum, it is not progressive in itself. But the protecting bark is gone and the next fire finds ideal conditions for further and greater damage. What is worse, the wounds caused by fire very frequently reach the heartwood and expose it to the attacks of heartwood-destroying fungi. Thus the relative importance of fires not fierce enough to kill is to be gauged not only by the actual amount of timber values destroyed, but also by their relation to subsequent injuries.

In the same way lightning cannot be rated merely on the basis of mechanical destruction of timber values. Lightning is one of the chief causes for forest fires and must, therefore, also be made, at least indirectly, responsible for the secondary damage.

It is clear that the basis for standardized rating must be the timber species and that every factor liable to produce cull must be treated separately. In pure stands this will be simple enough, but the fact must not be lost sight of that here aggressive cull factors such as certain insects or fungi are far more liable to do extensive damage than in mixed stands where the chances of infestation or infection are reduced in the ratio of representation of species.

The relation of the loss factor to representation of age classes and to cumulative risk must find its place in the rating. It is true that young trees before the formation of heartwood are immune against the ravages of heartwood-destroying fungi. Nevertheless, these young trees, which are subject to a number of diseases impairing their increment—in other words, suppressing their growth—gradually move up into the higher age classes when the very values resulting from this increment and stored in the shape of heartwood are subject to destruction through infection coming from leftover diseased trees, through

insects, lightning, storms or frost. In other words, the ratio of risk grows with time. The older the tree the greater the cumulative risk.

It seems quite feasible thus to devise a system of rating for the relative importance of all factors conducive to loss, which will eliminate the vagueness now so prevalent in the literature and will reduce to a minimum the temptation to gauge the seriousness of a disease according to the interest it presents to the botanist or mycologist.

The value of such a standardization of data gained from a point of view of forestry and given in definite symbols rather than in descriptive words is evident. Tables of cumulative risk will supplement yield tables. Areas of equal rating will naturally be drawn together in broad belts or zones showing at a glance all the competent factors of cumulative risk in the forest.

In a former paper[2] the author has proposed to establish broad zones of equal pathological conditions in which the cull per cent per species is given in definite figures. These zones record the past pathological history of the forest and its present condition. They will be of immediate use for the utilization of privately as well as Government owned timber. At the present time the estimate of cull is mere guesswork. It is impossible to predict with certainty the amount of sound timber a given tract will yield in cutting. The private timber owner and the timber buyer often experience very unpleasant surprises owing to the lack of reliable indications of the cull per cent. The Government is eually handicapped both in determining in advance the possible yield on a given area and in computing stumpage rates, on account of the uncertainty of this important factor.

Tables of cumulative risk and zones of equal relative importance of cull factors, on the other hand, are expected to be of assistance to silviculture in any endeavor to influence the future forests by rational management. They will give reliable information regarding all factors of loss to which growing forests are exposed.

The sanitation of the virgin forest as a first step toward regulation must be based upon standardized ratings. At the present time the attempt is made on Government timber sales to rid a given area at least of the more serious heartwood-destroying fungi, in other words, of those elements which affect the capital of timber in sight. The disease affecting the increment, the future crop, cannot yet be given the attention they will undoubtedly command in the future. Once an

[2] *Loc. cit.*, p. 57.

area is logged over it is left to itself, exposed again to cumulative risk from the cull factors encroaching upon the area from the outside. In other words, we have to a certain degree forest sanitation, but no forest hygiene. A large field for research and practical work lies before us, almost fallow. The sooner reliable and definite information concerning the factors of cumulative risk is available, the sooner will intelligent forest hygiene become a possibility instead of a chimera.

Immense areas of virgin forest are cut over annually in the United States, a comparatively small fraction on Government land, by far the greater part on private holdings. The practice of burning over the latter after logging and of leaving malformed trees as well as those of so-called inferior species tends to retard for a number of years natural reproduction, to alter to a certain degree the representation in favor of the inferior species and to prevent an equal and advantageous distribution of individuals. Since diseased trees generally are not cut, the young stand grows to maturity helplessly and hopelessly exposed to the host of unchecked, uncontrolled components of cumulative risk. In other words, the act of man here results in conditions very similar to those caused by the uncontrolled fires of the past, with this exception, that fires do not choose between valuable and inferior species. The future forest will be a duplicate of the virgin forest preceding it, with a possible preponderance of the inferior species. On the National Forests conditions are more favorable in so far as under the selection system prevailing at present only young, thrifty trees are left on timber-sales areas and reproduction is carefully protected against injury from logging operations and fire. Under the sanitation clause diseased trees and, wherever possible, malformed trees and snags are cut. In general the attempt is made to maintain the representation of inferior species or even to alter it in favor of more valuable timber through heavy marking, but more often the prejudice against inferior species on the part of the purchaser renders this eminently important operation illusorical or impossible. However, an area cut over under Government regulations starts on its career of producing a new timber crop with many advantages over adjacent privately owned areas logged under the prevailing system of turning timber into cash without regard for the future. Advance growth is protected, reproduction favored and controllable diseases are eliminated. But the total area of Government land annually cut over is small in comparison with that in private ownership. Furthermore.

this first silvicultural act of utilizing mature and overmature timber and eliminating diseased and generally undesirable trees, analogous to a first improvement felling, is also the last silvicultural act. The sales area, after a more or less thorough sanitation, is nothing but an enclosure in the vast surrounding virgin forest left to shift by itself and exposed to all the controllable and uncontrollable factors of cumulative risk. For a number of years the young forest enjoys all the advantages of increased light and space and of comparative freedom from disease, but in the course of time foliage and kindred diseases impairing the increment, and later also heartwood-destroying fungi enter the new forest from the outside. Here also the result of a first cutting in the long run can be nothing but another virgin, highly abnormal forest.

The forester cannot but view this development with grave concern. If there is any reason for the very existence of American silviculture it must evidently be to utilize mature and overmature timber for the benefit of the present owners and to adequately provide for the timber needs of future generations. But under no circumstances can the duplication of virgin, highly abnormal forests, with their tremendous loss from increment-impairing and heartwood-destroying fungi, from insects and other factors, be called adequate. Forest regulation, the backbone of any silviculture worthy of the name, means the closest approach to the ideal normal forest for the purpose of sustained yield. The European forester operates in the already regulated forest. In America, as in all newly settled forested countries, the virgin forest, not the regulated forest, is the starting point, the raw material to be shaped by the art of silviculture.

The only silvicultural operations of American forestry at the present time, unless supplemented in due season by further activities, cannot result in anything but the creation of a second virgin forest minus the large values accumulated in very old trees, for it is not to be assumed that future generations will be able to afford to wait for several centuries before they go back to areas once cut over. Forest regulation is simply put off indefinitely. A great deal of the initial expense of the first improvement felling will be lost. The next improvement felling, if left to future generations, will cost not much less than the first and there will be no timber values accumulated through centuries to pay for it, as they do now, even taking into account the steady advance in value of the inferior species and lower grades.

Obviously the only logical way out of the dilemma is to couple forest sanitation with forest hygiene; that is, to regard an area taken under treatment by a first cutting as part of the regulated forest of the future, after thorough sanitation to continue the treatment in regular intervals and to prevent by all means reversion to the virgin forest type.

It is deeply to be regretted that for the present, at least, there is no immediate hope for such a course. The private owner of timberlands can hardly be expected to express his active interest in the future through heavy, in fact, prohibitive, financial sacrifices, and activities on National Forests are necessarily limited to those authorized by law, consisting mainly in utilization of accumulated values, in planting and protection from fire.

The outlook at the present is far from encouraging and still no one doubts that the advent of forest regulation is inevitable. If the character of contemporaneous publications and periodicals counts for anything, the profession is deeply interested in this phase of development. But one cannot help seeing that wherever speculation tries to break away from European precedent as based on the accomplished fact of regulation, it is hampered by the lack of a solid foundation. of knowledge as the only basis for understanding.

Forest regulation is unthinkable without forest sanitation and forest hygiene; that is, practical forest pathology. Forest sanitation applies to the untouched virgin forest, the wild forest, so to speak. For this reason America cannot look to Europe for information and instruction. Sanitation came to European forests gradually, through centuries, without the help of science. Forest hygiene is practiced in European forests as a matter of routine, inseparable from the concept of regulation. The period of transition, the conversion of virgin into regulated forests in Europe, is past history. To the American forester it is, next to the utilization of accumulated timber values, the one great and pressing problem. In the solution of this problem American forestry must stand on its own feet.

This much is certain, that forest sanitation and forest hygiene. the elimination and the control of avoidable injurious factors, must play a far more eminent rôle during the period of transition than was ever assigned to them in Europe, and that for this reason silviculture in America must be closely linked with forest pathology.

The great problems of forest pathology are those of silviculture during the period of transition from virgin to regulated forests.

SOME PROBLEMS IN LIGHT AS A FACTOR OF FOREST GROWTH[1]

By Raphael Zon

No other climatic factor has such direct bearing upon forest growth as light. It enters into the question of natural reproduction of the forest, in the artificial raising of stock for planting in the forest; it plays an important part in regulating the degree of cutting and thinning; it determines the structure of the forest stand—whether one-storied or many-storied forest. It is light which largely determines the height growth of the trees in the forest, the rate with which stands begin naturally to thin out with age, the progress of natural pruning, the character of the living ground cover, the vigor of young tree growth, the natural differentiation of trees in a stand into dominant, codominant, intermediate, oppressed, and suppressed; it affects the seed production of trees occupying a different position in the stand with relation to each other and affects many other phenomena upon which the management of the forest depends. In no other plant community does light play such an important part as in a forest. A thorough understanding, therefore, of the effect of light upon the life of trees in the forest, and a knowledge of the methods by which the extent of this effect can be determined, are essential for a proper understanding of the life of the forest and successful handling of the forest.

From the standpoint of the forester there are three points in the study of light that deserve particular consideration:

1. Should there be undertaken comparative measurements of total solar radiation at different latitutes or should the investigator confine himself only to the measurements of light actually utilized by the different life processes of the plant, such as the formation of chlorophyl, photo-synthesis, and so on?

2. Should there be qualitative measurements of light which penetrate the canopy of the forest or should the light in the forest be considered as of the same quality as the light in the open, but only of lesser intensity?

3. To what extent do heat, moisture, and fertility of the soil modify the effect of light upon the life processes of the same species and by what methods can the effect of each of these compensating factors be determined?

---

[1]Presented at the New York meeting of the Ecological Society, Dec. 29, 1916.

1. Total Solar Radiation

It is generally accepted that plants need less light as the temperature rises and more light as it falls. This is seemingly true not only for changes of temperature with latitudes but also for those due to differences of altitude. Hann's example of the difference in the minimum of light necessary for *poa annua* in Cairo and in Vienna, due to the differences in the solar radiation received at the two places, is well known.

Hann emphasizes the need of measurements of the strength of the sunlight and of the heating effects of direct solar radiation, which should be supplemented by measurements of the chemical activity of this radiation. These climatic elements have thus far been sadly neglected. He expresses the hope that when the seriousness of this deficiency becomes known, the difficulties that still stand in the way of such measurements will speedily be overcome.

On the other hand, the forest investigator is concerned chiefly with the weaker diffused light actually utilized by the trees than with the total solar and sky radiation. Most of the life processes, such as the formation of chlorophyl, photosynthesis, etc., take place in very weak light intensities. Direct sunlight in many cases is actually injurious to the chlorophyl grains, and to transpiration, and other functions of the tree. There can therefore be but little question as to the total solar radiation being anywhere at the limit or even near the actual requirement of forest trees, since even in the shade of the densest forest there is enough light to cause the formation of chlorophyl bodies.

Even should there be any need for determining the total solar radiation at any geographic latitude, could it not be determined mathematically from the observations carried on at a few places in the United States instead of undertaking such complicated observations at a large number of field stations?

Since, however, there are some investigators who lay great emphasis on solar radiation and insist on its measurements at nearly all of the experiment stations, this question, in my opinion, is one upon which further investigations are needed.

2. Spectro-photometric Measurements

Are spectro-photometric measurements essential for studies of plant growth? According to a number of investigators, such as Reinke, Fr. Czapek, Bonnier and Mangin, the quality of light has not such an

importance for the different life processes as it was thought before. Thus, for instance, the formation of chlorophyl takes place, although with a different degree of rapidity, in all visible rays between A and H. The light which penetrates through the dense crown canopy and lacks the red rays can still cause the formation of chlorophyl grains. Assimilation, although it takes place most vigorously in the presence of red rays, still may go on in the presence of blue, green, and even ultra-violet rays. If this is the case, then the difference in the quality of the light in the forest cannot have an important effect since the same life processes can go on in the presence of different rays and the quality of the light in the shade of the forest may for all practical purposes be considered the same as the ordinary daylight but of weaker intensity.

If this could be definitely settled once for all it would facilitate the solution of many forest problems. Thus, for determining whether a certain tree species could come up and grow in the shade of other tree species, all that would be needed is a determination of the minimum light intensities under which this species can grow without going to the trouble of determining the quality of the light. The measurement of light intensities can be made very quickly and very simply either with Wiesner's or with Clements' photometer, while the determination of the amount of the different rays of the spectrum would require numerous observations by means of complicated and cumbersome spectro-photometers, ill adapted for work in the forest.

There are two schools: the one led by Professor Wiesner claims that the light in the forest is practically of the same quality as that of the open and can be measured by its action on sensitive paper; the other, at the head of which is Zederbauer, claims that the quality of the light in the forest is different from that in the open and that each portion of the spectrum must be measured separately if we are to understand the effect of light upon forest growth. Zederbauer's investigations show in particular that the foliage of so-called shade-enduring species, such as spruce, beech and fir, absorb most of the red, blue to violet rays while the foliage of the light-needing species, such as pine, larch and birch, absorb less of the red, blue to violet rays than the shade-enduring species. In the shade of a forest stand composed of some shade-enduring species, the quality of the light must therefore be different from the kind of light that is to be found in the shade of a forest stand made up of light-needing species. Under the shade of a

light-needing pine forest, for instance, the light must still have a great amount of red, and particularly of blue and indigo, while in the shade of a shade-enduring spruce forest the light is poor in red, blue, and indigo rays.

Numerous laboratory observations similarly showed that the sun leaves and the shade leaves of the same species absorb different amounts of different rays of the spectrum. If this is the case, the question of the value of the quality of light in the forest and its effect upon the coming up and development of the young growth can be settled, in my opinion, by a comparatively simple series of experiments. The experiments suggested may be carried out as follows:

Locate two forest stands of which one should be composed of a light-needing species, such, for instance, as western yellow pine, and the other of Engelmann spruce or Douglas fir. In the central Rockies such stands can be found close to one another. Find some small areas in these two stands where the light intensities as measured with Clements' or Wiesner's photometers at the same time of the day are nearly the same. Locate on those areas a number of young plants of different species—shade-enduring and light-needing—of the same age, origin of seed, and treatment; if necessary, in pots or, if the soil is the same, in the two stands, in a nursery bed especially prepared for this purpose, and give the plants the same amount of water and care. Spectro-photometric measurements should be made under the canopy of the two stands. Observations for several years upon the growth and development of these seedlings in the shade of the two stands similar in practically every respect except the quality of the light, should bring out definitely, if even only empirically, the significance of the effect of different rays of the spectrum upon the development of young growth in the forest. This, in my judgment, is another problem upon which investigators should concentrate their attention and point out the road to its solution.

3. *Compensating Factors of Light*

The effect of "light" upon forest growth is still little understood. In part it seems to be the luminous and chemical rays that have the greatest effect, in part it appears to be the heat rays; furthermore, the effect of all these elements of solar radiation appears to be further modified by favorable soil conditions, such as moisture and fertility. Many observers have established the fact that the same species grow-

ing in different geographic regions seemingly requires different amounts of light for its best development. In one place it can get along with very little light, growing under the shade of other trees; in other places it needs almost full daylight.

What is the cause of this difference in light requirements of the same species?

Among practitioner foresters there is a common opinion that the same species can get along with less light, the richer and more favorable are the soil conditions and the warmer the climate. They base their cultural operations on this generally accepted theory. Can heat, soil fertility, and soil moisture compensate for light? As for heat, there are good reasons to believe that since heat and light are merely different modifications of the same radiant energy, differing only in the length of the waves. Both of them, or their sum, therefore, can be considered as one factor. Moreover, it is well known that heat in general affects the rapidity and energy of all chemical processes. It can therefore be assumed that it affects also the process of assimilation of carbon dioxide (CO_2). As a matter of fact, there are observations which clearly show that the greatest production of dry substance can take place in light intensities which may be the weaker the greater is the temperature and the amount of chlorophyl in the leaves of the plant.

The assumption, however, that soil moisture or soil fertility does compensate for deficiency in light would seem to be open to serious doubt. It is certainly in contradiction with Liebig's law of minimum which, in my judgment, applies to all factors of forest growth. This law may be formulated as follows:

The life and the development of a plant is controlled by that factor which under given conditions is nearest to the minimum limit absolutely necessary for the life of the plant.

Since without a proper understanding of the factors that modify the effect of light the true value of light as a factor of forest growth cannot be definitely settled, I would like to see this committee suggest a series of simple experiments which might take us a peg further in the solution of this problem.

1. *A Test for Determining the Effect of Soil Fertility upon Shade Endurance of Forest Trees.*

If the capacity of a species to withstand shade increases with the improvement of the soil conditions in which it grows, then it should

be possible to organize an experiment in which all factors of growth, except light, should be favorable, while light should be at its minimum. The experiment can be arranged something like this:

In a nursery bed in which the soil is fresh and fertile, raise or plant out seedlings of several light-needing and shade-enduring species, say larch, Norway pine, spruce, and white oak. Divide the bed into several parts, each containing rows of all of the four species, and cover three such parts of the bed with ordinary boxes from which the sides facing north have been removed. The light would thus reach the seedlings only from the north. Beside the three boxes covering three lots of the different seedlings the rest of the bed should be used as control lots for comparing them with each lot covered with the boxes. The light under the boxes in the middle of them should be about one-twentieth of the daylight or at any rate it should be of such low light intensity as would prevent the seedlings, even of the most tolerant species, from growing naturally in the forest. The seedlings nearest to the open on the north side would receive, of course, most of the light, and those farthest removed from it the least. The factor which will be at its minimum will be light. The soil under one box should be watered occasionally when it gets too dry. The soil under another box should be watered more often, while the soil under the third box should be watered with solutions containing a complete fertilizer. If improvement in the soil fertility can compensate for deficient light, then the plants under the third box should have a greater survival and better development than in the other two boxes. This difference should be particularly greater in the case of the light-needing seedlings than in the shade-enduring ones. If, on the other hand, the mortality of the seedlings in the third box is as great, or even greater as I expect it will be, than in the two other boxes, then the conclusion would seem to be that soil fertility cannot take the place of deficient light and that the general belief that fertility of soil increases the tolerance of trees must be based on faulty observations. There is no doubt that there are reliable observations which showed that trees growing in the shade have often improved in growth with the improvement in the fertility of the soil. It is questionable, however, if in such observations there has ever been made an attempt to ascertain whether it was not the fertility or the moisture of the soil that was farthest from the optimum for forest growth than light. If it were soil conditions that were below the optimum, then it is only natural that the growth should have im-

proved with improvement in the soil conditions. My feeling is that the seedlings in the third box which are to be watered by nutritive solutions will show greater mortality, and is based on the theory that trees, in order to assimilate larger quantities of nutritive substances contained in the soil, must have proportionately a greater amount of light to enable the plant to assimilate the available food. For a given amount of nutrition in the soil there must be a proportionate amount of light above the soil. Since the light under the third box is at the minimum essential to the life of the seedlings, while the soil conditions probably at their optimum, the consequent loss of the seedlings therefore must be greater. In other words, this experiment, I expect, will prove not only the falsity of the general belief that trees become contented with less light when grown on fertile soil but that just the reverse is the truth, namely, that with greater soil fertility the light requirements of trees increase.

2. A Test to Determine the Effect of Heat upon the Tolerance of Forest Trees.

In order to determine whether heat can change the light requirements of forest trees the following experiment may be suggested:

Rows of seedlings of several species with different light requirements, say the pine, spruce, and oak, should be covered with boxes in the same way as in the test of the effect of soil fertility. To provide, however, for a difference in the temperature conditions under the boxes, each lot of seedlings should be covered with two kinds of boxes—one painted a shiny white, the other a dull black. The lots of seedlings under these two kinds of boxes will then have the same minimum of light and similar other conditions except heat. The difference in heat under the two kinds of boxes which can be secured will probably be not very great during one day—at most one or two degrees—yet the total sum of heat received during the entire vegetative period by the plants under the black boxes will be considerably greater than that under the white boxes. Both the temperature of the air and the temperature of the soil under the boxes should be recorded in the usual manner. If the plants under the black boxes show a larger survival and better development than the plants under the white boxes, then it is evident that heat, either because in this experiment it is, like light, also at its minimum, and therefore its increase improves the growth, or that heat in general increases the energy of assimilation

by increasing the coefficient of the useful action of light. If heat can increase the energy of assimilation and transpiration and consequently the nutrition of the tree, then in a warmer climate forest trees must produce under the same soil and light conditions more wood than in cold climates.

These experiments can undoubtedly be made more elaborate. In suggesting them my aim is to bring out the principles involved rather than the details of arrangement.

THE RÔLE OF LIGHT IN NATURAL AND ARTIFICIAL REFORESTATION*

By Carlos G. Bates
Forest Examiner, Forest Service

In the common conception the word "light" refers only to visible rays of the solar or other spectrum. In the physical conception the word is synonomous with radiant energy, and includes the calorific as well as the visible and actinic rays of the spectrum. In physiological and ecological works there is reason to believe that the term is used rather loosely. Thus Schimper[1] in his "Plant Geography" neither defines the term light, nor makes any mention of the effect of radiant energy on transpiration, and throughout the discussion of light appears to be treating solely of visible and actinic light. On the other hand Warming[2] states that the term is used to express radiant energy, and states that "light is one of the most important factors influencing transpiration." Clements[3] treats of the *influences* of light as those of radiant energy in general, but treats of the *measurement* only of the chemically active rays.

The foresters' conception of the term "light" is generally the common conception of *visible* rays. For the time being I shall consider the role of light in the forest only in the sense of rays measurable by photometric means. This may include some of the ultra-violet as well as visible rays.

The four important forest trees of the central Rocky Mountains may be listed in the following order as regards their apparent requirements for light, the most light-demanding appearing first: Yellow pine, lodgepole pine, Douglas fir, and Engelmann spruce. At the end of this list might be added alpine fir, the least demanding of all, and at any point in the list might be placed limber pine, which is exacting neither as regards light nor soil nor soil moisture. The above is purely an empiric "scale of tolerance" such as all foresters make from general observation. Such scales are ordinarily based on the densities of the

*Presented at the New York meeting of the Ecological Society, Dec. 29, 1916.

[1] Schimper, A. F. W. "Plant Geography upon a Physiological Basis." Oxford 1903.

[2] Warming, Eug. "Oecology of Plants." Oxford, 1909.

[3] Clements, F. E. "Plant Physiology and Ecology." New York, 1907.

stands in which the trees grow, and on this general basis there would be a very wide divergence in tolerance between yellow pine and spruce. That there is not, however, a very wide difference in light requirements of the various species is indicated by the fact that occasional yellow pine seedlings appear in the densest stands of Douglas fir; likewise lodgepole reproduction is frequently abundant in spruce stands where deficient soil moisture opens the stand slightly.

For germination either in the greenhouse, nursery, or field, we may state it as an established fact that light is not required. Light itself cannot affect the seed or seedling which is covered by soil or litter, and can act only through the agency of soil temperatures. With the possible exception of Engelmann spruce and balsam, germination of our trees occurs in the field under the densest shade which is likely to be encountered. That Engelmann spruce germination should be influenced by light is plainly due to the low temperature of the soil, which in the dense spruce forest may be little above 32° F. at midsummer.

While any of our species will germinate with a very small ration of light, and the seedlings survive for some time on the food furnished by the endosperm, there is always much more germination in shaded places than survival after a year or two. Other factors than shading, of course, tend to destroy the seedlings, but this is one of the most important.

Pearson,[4] by measurements with the Clements photometer, has determined that good growth of yellow pine seedlings occurs with a relative light intensity of .414; of Douglas fir with about .125, and white fir about .027. Notestein,[5] in a stand mainly of Douglas fir, found seedlings of both Douglas fir and Engelmann spruce most numerous where the light intensity was about .100 and concluded (1) that there was abundant light for these seedlings anywhere in the Douglas fir stand, and (2) that the lack of them in openings was explained by a deficiency of soil moisture. Permanent sample plots in lodgepole pine show that, while lodgepole seedlings start in great numbers where the average light intensity is .350 or less, they only survive in considerable numbers where the intensity is above .400. On the other hand, with an intensity of .750 germination is greatly reduced by drying of the surface soil, but the survival and rate of

[4] Pearson, G. A., contributor. See footnote 9, p. 236.
[5] Notestein, Frank B., Forest Examiner. Unpublished report, 1913.

growth of the seedlings is very high. Clements[6] states that the best growth of lodgepole seedlings is secured only in full light, but he found fairly good growth with intensities as low as .140. The writer found abundant and vigorous reproduction of Engelmann spruce and alpine fir in a stand where the measured light intensity was about .450. In Oregon[7] good growth of this species was found with an intensity of .021.

An exact determination of optimum light conditions for seedlings is almost out of the question, because there is no exact standard as to what constitutes good growth. Considering only those measurements which refer to the minimum of light under which life may be sustained, we should have rounded figures for the various species about as follows: yellow pine .250; lodgepole pine .100; Douglas fir .050; Engelmann spruce and alpine fir from .020 to .050. Yet we have evidence of the inexact determination of even these minima, by the occurrence of seedlings of all species, except possibly yellow pine, where light intensities are not over .010.

For nursery conditions we have very little data. All of the Rocky Mountain species commonly grown for reforestation purposes succeed admirably with a light intensity of .500. This is the degree of shading usually given for practical reasons, being productive of taller plants than are produced in full light. With western yellow and jack pines, the latter strongly resembling lodgepole, experiments were conducted at the Halsey nursery, where atmospheric and soil temperatures are far above the normal for habitats of both species. Under these conditions, only in one year, when the temperature and sunlight were considerably below normal, has less than 50 per cent shade appeared to be favorable. With light intensities of .400 and .200, there has been marked diminution of growth, and with the least of these, even considerably retarding of germination, but it is safe to say that an intensity of .200 is far above the minimum requirement of either species, when other conditions are favorable.

Zon and Graves[7] have pointed out that empiric scales of tolerance have usually proven of just as great final value as the more exact

---

[6] Clements, F. E. "The Life History of Lodgepole Burn Forests." Bulletin 79, U. S. F. S., 1910.

[7] Zon, R., and Graves, H. S. "Light in Relation to Tree Growth." Bulletin 92, U. S. F. S., 1911.

scales prepared by Wiesner and others after photometric measurements in the forest. In fact the latter tend to confuse, rather than clarify our conceptions of tolerance. The tendency of foresters, as shown by the writing just cited and by Burns,[8] is to refuse to accept photometric results when they do not agree with empiric conclusions. I do not know of a single forester who has worked extensively with this subject who would be willing to substitute a scale of light demands obtained by photometric measurements, for the scale of tolerance which he has developed from experience. This is a rather serious indictment of ecological methods. But they have failed to produce convincing results.

One view of the matter is this: foresters have measured the light factor without measuring all of the other factors which control the existence and the growth of seedlings in the forest. As early as 1907 Zon[9] pointed out the importance of root-competition in creating the appearance of shade-suppression, and admonished foresters to "look down, rather than up" for the explanation of so-called shade tolerance. It has also been pointed out[10] that less light is required for trees growing on good soils than for the same trees on poor soils, and elsewhere I have mentioned the possible bearing of soil temperatures on the requirement for light. Considering the wide variation in limiting light intensities which have been shown by different authors and in different localities, one might almost conclude that these other factors were all-important, and that light was really not a limiting factor at all. While this is going to an extreme, we simply must admit that light measurements are of no value alone.

Another view of the reason for the failure of field measurements to establish the physiological importance of the light factor is that the method has been photo-chemical instead of photo-thermal. Foresters have been perhaps the slowest to recognize the deficiency of photochemical measurements, and although the Wiesner-Clements method has been subjected to a great deal of criticism beacuse it takes account of only one kind of rays, while the intensities of other rays may or may not vary proportionately in different spectra, nevertheless forest-

---

[8] Burns, Geo. P. "Discontinuous Light in Forests." Bulletin 193, Vermont Agr. Exp. Station, 1916.

[9] Zon, R. "A New Explanation of the Tolerance and Intolerance of Trees." Proc. Soc. Am. Foresters, II, 1, 1907.

[10] "Zon R., and Graves, H. S. "Light in Relation to Tree Growth." Bulletin 92, U. S. F. S., 1911.

ers have overlooked the greatest fault of this method and have used it almost exclusively. The importance of photo-thermal measurements was mildly emphasized by Dr. Livingston [11] in introducing his radio-actinometer some five years ago, and has doubtless been recognized by laboratory scientists for a much longer time. But I do not know of a single instance in which the question of tolerance of forest trees has been considered on the basis of the physical, rather than the chemical effects of light, and I seriously doubt whether ecologists in other lines have made much use of this conception.

To bring out the importance, to foresters at least, of considering the rôle of light on a physical basis, there are two points which I wish to emphasize. First, without any argument as to the function which transpiration may have beyond its incidental occurrence with photosynthesis and respiration, one should recall that, of the total radiant energy incident upon the leaf, only about 5 per cent, according to Clements,[12] is used in photosynthesis, and that at the most, all of the activities which seem to require chemical rays probably do not utilize more than 10 per cent of the heat value of insolation. The remaining 90 per cent of the power of radiant energy is transformed into heat, which raises the temperature of the plant to a point suitable for all physiological activity, and beyond this is utilized almost exclusively in changing water to water vapor. In either of its thermal effects, radiant energy becomes inseparable from heat which may be obtained by conduction from the air.

The second point is this:

The fallacy in the present method of measuring radiant energy by photometric means does not, as many writers have urged, consist primarily in the existence of variable proportions of chemically active and heating rays in different spectra, but consists in the fact that the *effectiveness of rays for heating purposes is proportionate to their intensity only in a vacuum or in still air.* It is demonstrable with the simplest of physical apparatus (*e. g.*, a blackened thermometer bulb) that the temperature of a body which absorbs radiant energy uses in still air to a point where radiant from the body is exactly equal to absorption. The slighest disturbance of the air around the body upsets this equilibrium and by increasing conduction, lowers the temperature.

[11] Livingston, B. E. "A Radio-atmometer for Comparing Light Intensities." Plant World, XIV, 4, 1911.

[12] Clements, F. E. "Plant Physiology and Ecology." New York, 1907.

Thus a body, which would become superheated to the extent of 20 degrees in still air, would show possibly only 3 or 4 degrees of excess temperature in a current of air moving at the rate of 200 or 300 feet per minute.

It is perfectly obvious that this simple physical fact explains in a large degree the ability of plants to exist with very low light intensities. Heavy shade in the forest or elsewhere is almost certain to be accompanied by stagnation of the air. Light of 10 per cent intensity in the densest forest may be equivalent in heating value to full light at the crowns of the taller trees.

If we apply a measure of the heating effect of insolation to the light intensity figures mentioned in the early part of this paper, on the basis of the relative wind exposure likely to be met with in the forest types where the measurements were taken, we have figures for the different Rocky Mountain species roughly as follows:

Species	*Minimum Light Sustained Growth*	*Heating Factor on basis of Air Movement*	*Net Heating Result*
Yellow pine	.250	.20	.050
Lodgepole	.100	.40	.040
Douglas fir	.050	.80	.040
Spruce and fir	.020–.050	1.00	.035

These figures are, of course, the merest approximations, and I have introduced them simply to show that a consideration of light values in connection with their probable physical effects tends strongly to eliminate the discrepancies between species which have been so disconcerting. I am convinced that similar treatment of all photometer results would bring different measurements much closer together and would tend to show that chemically active light was not the controlling factor at all.

My message to foresters, which may or may not have interest for more advanced ecologists, is simply this: If we are to obtain a solution of the problems which are conceived in the terms "tolerance" and "intolerance," and if we would give quantitative expression to the requirements of the various species of light, we must consider this factor in its full meaning of radiant energy; we must consider the physical value of radiant energy rather than its chemical value; and finally we must determine its effective physical value in combination with the heat of the air rather than its theoretical physical value. Such determinations will soonest lead to conclusions if carried on where

other factors may be fully controlled. But the application of this idea in the forest should tend to clarify empiric ideas of tolerance, as well as to furnish measurements which will be logical and hence convincing. Photochemical measurements, and measurements of total radiant energy are highly to be desired, but to be useful for correlation with tree growth must be integrated with measurements of air temperature and air movement. The ideal will have been reached only when we have an instrument which integrates these several factors in the same way as the plant does it. For the present, the nearest approaches to the measurement of the effectiveness of radiation would appear to be had in evaporimeter readings and in comparisons of blackened and shaded thermometers. The former should be given preference because they express the result in terms comparable to transpiration. The latter may be useful in indicating plant temperatures and the possibility of physiological activity, when these cannot be determined more directly.

NOTES AND COMMENTS

A recent decision of the New Jersey court of errors and appeals sustains a principle which is of great importance to forest conservation and development. This was the case of the Department of Conservation and Development *vs.* Veeder, in which the decisions of the lower courts were overruled.

On April 24, 1912, Peter Y. Veeder, a farmer in Ocean County, undertook to burn over his salt meadow, having obtained from the local fire warden the required permit. A change of wind caused the fire to escape from the control of himself and his helper so that over 200 acres of adjacent woodland were burned. This constituted a violation of the forest fire law, which provides that "no person shall set fire to, or burn, or cause to be burned, any waste land, brush land, or forest lands. . . ." The escape of the fire apparently was due to no neglect or carelessness but to pure accident, and Veeder had shown his good faith by securing the permit required by law. The department therefore offered to settle the case by permitting Veeder to pay the cost of extinguishing the fire for which he was responsible. He refused this settlement and the matter was put into the hands of the attorney general's department for prosecution. The case was first heard in the court of a justice of the peace, where a decision was rendered in favor of the State. Veeder appealed to the court of common pleas, which declared a nonsuit on the ground that the defendant did not intentionally or wilfully violate the law. On writ of certiorari to the supreme court, the judgment of the court of common pleas was affirmed. The case was then carried by the State to the court of errors and appeals, and in an opinion rendered by Chief Justice Gummere the judgment of the supreme court was reversed. The opinion holds that the act of the defendant in allowing the fire to escape was a violation of the statute, notwithstanding the fact that it was unintentional.

The ruling of the supreme court made it impossible to enforce penalties for forest fires, because in practically every instance these fires are due to carelessness or ignorance rather than maliciousness or intent. The opinion of the higher court in reversing the ruling of the supreme court demands provision against possible as well as

existing elements of danger. Based on the principle that responsibility exists aside from intent, the decision is a far-reaching and sweeping victory in the work of forest fire control.

Secretary Houston has just announced the plan to be pursued in spending the $10,000,000 appropriated by the Federal aid road act for the construction and maintenance of roads and trails within or partly within National Forests, and has tentatively allotted among the various National Forest States the million dollars which is expendable this fiscal year. The tentative allotments to the principal National Forest States are as follows: Alaska, $46,280; Arizona, $59,950; Arkansas, $11,294; California, $140,763; Colorado, $62,335; Idaho, $108,010; Montana, $89,901; Nevada, $19,195; New Mexico, $42,622; Oregon, $127,794; South Dakota, $8,115; Utah, $40,982; Washington, $91,739; Wyoming, $40,566.

The method followed in apportioning the money was explained by Secretary Houston as follows: Ten per cent of the amount available each year will be withheld as a contingent fund. One half of the remainder will be allotted to the States in amounts which will be based on the area of National Forest lands in each State. The other half will be apportioned on a basis of estimated value of timber and forage resources which the forest contains. Amounts apportioned unexpended within three years, and any balance of the contingent fund which remains unapportioned at the end of each year, will be reapportioned on the same basis as the original allotments.

The eighth annual meeting of the Commission of Conservation of Canada met at Ottawa on January 16 and 17. The acting chairman, Senator Edwards, made a short opening address, in which he took the position that all resources of Canada, her timber wealth included, were much overrated. The address of the permanent chairman, Sir Clifford Sifton, read in his absence, was a statesmanlike presentation of the situation in Canada and review of the work of the commission. Only two papers on forestry matters by outsiders were presented, namely, a description of the cooperative fire protection organized in Quebec, by H. Sorgius, and a description of the forest survey and land classification undertaken by New Brunswick, presented by P. Z. Caverhill. The report of the committee on forests was summarized by Clyde Leavitt, the forester of the commission.

The lack of personnel to carry on investigative work, due to enlistments, has hampered development, yet progress has been made by the inauguration of the New Brunswick survey, by the proposed reorganization of the Ontario fire control service, by the market extension work of the British Columbia Forest Service.

The war against the pine blister disease came in for attention, and an appropriation of $50,000 for its continuance was recommended. The report on the British Columbia forest resources, by Dr. H. N. Whitford and R. D. Craig, was announced to have nearly reached its completion, and a continuance of this stock-taking in Ontario and Quebec, with special first reference to pulpwood supplies, was announced, and a study of reproduction on cut-over lands was recommended.

A very successful forest conservation conference, the first of its kind to be held in Canada, met in Montreal on February 1 and 2, under the auspices of the Lower Ottawa and St. Maurice Forest Protection Associations. The purpose of this conference was to bring together all parties interested in the protection of timberlands for the exchange of experiences and discussion of plans for improvement of methods. Delegates were present not only from most of the eastern Canadian Provinces, but also from a considerable number of the States. These latter included Mr. E. T. Allen, forester for the Western Forestry and Conservation Association, and Mr. Howard, of the State of New York. Two sessions were held each day, covering a very interesting program, which included not only methods of forest-fire protection and the operation of cooperative associations, but also such subjects as protection against insects, white pine blister rust, and the use of various forms of mechanical equipment in forest protection activities.

The Conservationist is the title of a new monthly, published by the New York State Conservation Commission, the first number of which was issued in January in a neat, well-papered, well-printed, and well-illustrated issue of sixteen pages. The Conservation Commissioner himself opens the ball with a discussion on public policy in relation to forest lands, from which we learn that the park idea is bound to prevail. A good argument for this attitude is found in the statistics of tourist travel as exhibited in a canvass of the year 1903,

when over 450,000 people were accommodated in the hotels during the season, over 26,000 people being engaged as help, and the receipts ran to $8,725,000, which is a sum about equal to the combined wages and stumpage values of that year's lumber production in the Adirondacks, and it is suggested that the lumber industry "amounts to probably not more than 20 per cent of the business of the Adirondacks."

It appears that the referendum to the people of the provision for additional purchase of State lands was an alternative to a proposition to regulate cutting of timber on private lands. Some arguments in favor of the latter proposition are also advanced. The vote on the former proposition showed a favorable majority principally in Greater New York, and in the whole State not more than 150,000.

There are four timber protective associations in northern Idaho. The annual reports of two of these are before us.

The Potlatch Timber Protective Association in Idaho, in existence since 1907, controlling 330,000, and patrolling 600,000 acres, reports, owing to most favorable weather conditions, only one fire without damage (an old burn), put out promptly at little expense; the total assessment being 2½ cents per acre as against 6 cents in 1915, and 25¼ cents in 1914; the total expenditure of the year being $13,680 as against $100,217 in 1914, when over $82,000 were spent in putting out fires, and the patrolling absorbed more than double the expenditure for that item in 1916. The report explains the difficulties which the association has repeatedly experienced in collecting the assessment from one of its members, the State, which owns some 500,000 acres of good timber. With the assistance of Weeks law funds and the Forest Service, a relief map of a part of the association's territory as an aid in detecting, locating, and controlling forest fires, was constructed last summer, and this has created an enthusiasm for such map work for other purposes. The report contains a very detailed account of how such a map was made with costs—namely, 4 1/3 cents per acre.

The Coeur d'Alene Timber Protective Association, in Idaho, in its eleventh year, reports for the year 1916 24 fires (of which three from lightning), most of which were easily extinguished and did little or no damage; only one destroying 80,000 feet of white pine. This was, however, in an unusually favorable season. The actual cost of the season's operation was slightly above 2 cents of productive acreage, the assessment being 1 cent per acre over all.

The fire loss in the National Forests during 1916 was only $162,385, covering nearly 300,000 acres, the smallest loss since the establishment of these Forests, the season being specially favorable, except in Colorado and Wyoming. It is significant that 44 per cent of the area burned was located in Arkansas and Florida.

Of the 5,655 fires, 73 per cent were confined to areas of less than ten acres. Lightning was responsible for as much as 23 per cent of the fires. The average cost of fighting fires was approximately half that of former years.

Under new legislation forest fire wardens in New Jersey take office this year for a three-year term instead of for a single year as heretofore. This refers to fire service with 350 local wardens serving 150 townships or other municipalities. The total number of fires in the last year was 583, little more than half as many as in the previous year. And of these 583 fires, 54 per cent were not allowed to burn five acres. Further, aside from woodlands the fire wardens and their helpers saved over $200,000 worth of property from fire.

According to a canvass made by the United States Forest Service as regards frequency of lightning strokes experienced the following sequence of species is given, based on 2,000 trees. The most frequently struck species is chestnut, then follows pitch pine, rock oak, white pine, hemlock, red oak, white oak, black oak, locust, sugar maple.

The bureau of industrial research of the University of Washington has recently concluded an investigation of the influence of a creosoted pipe line upon drinking water which passed through it. The tests showed in an experimental pipe line, which had been in use for twenty-nine days, that no taste whatever could be noticed in undiluted water passing through it. This experiment is of much value in that a pipe line of creosoted staves will last longer than a steel pipe and cost about one-half as much. The city of Seattle is considering the construction of such a pipe line to carry drinking water to the central distributing plant.

Tests at the Forest Products Laboratory, at Madison, Wisconsin, indicate that by the use of four additional nails in each end an increase of 300 per cent in the strength of canned-food boxes is secured.

Approximately 10,390 acres of denuded lands within the National Forests were reforested in the fiscal year 1916. The total number of trees planted was 6,146,637, while 8,280 pounds of tree seed were sown.

The National Lumber Manufacturers' Association, in its campaign for extending market for lumber, has established an engineering bureau (E. A. Sterling, F. E., Cornell, in charge), which issues a series of "Technical Letters," short and practical bulletins on various uses of wood, written by experts. Nine such letters, running from four to twelve quarto pages, are before us. The subjects so far discussed are: Creosoted wood block paving, and specifications for same; tests of fire retardents, undertaken by agents of the association, with special reference to shingle roofs; building code suggestions regarding details of construction; economics of concrete and timber factory buildings; timber in pier and wharf construction, and descriptions of Chicago's great $4,000,000 pier and other docks.

We cannot but admire the scientific spirit which lies behind this commercial advocacy of the use of wood, which cannot fail to increase its more rational employment.

A rapid method of kiln-drying eastern hemlock has been developed at the Forest Products Laboratory at Madison, Wisconsin, whereby shiplap can be dried green from the saw to shipping weight in 48 hours. By this method two-inch planks can be dried to shipping weight in six to eight days.

Announcement has been made by the United States Forest Service that a census of the lumber products of the country for 1916 will be undertaken by the Lumber Manufacturers' Association. There are over 30,000 sawmills in the country, and it is planned to have complete data from every sawmill in operation.

An investigation recently completed at the Forest Products Laboratory, Madison, Wisconsin, was designed to show the cost of waste disposal in lumbering. The result arrived at is that for every 1,000 feet of lumber sawed in the United States it costs from 11 to 22 cents for disposal of waste material yearly, the total for the United States annually amounting to about $6,000,000. An account of this

experimental work is to be found in Canadian Forestry Journal, 1916, pp. 809-11.

Notwithstanding the difficulties of freighters, Sweden maintained fairly well in 1915 its export to Great Britain of chemical pulp to the amount of 382,000 tons, and of mechanical pulp of 543,000 tons, while an increase of import in matches is recorded equal to the total importation from all countries before the war.

After years of study and experiment, artificial wood has been produced, says the American consul at Lyons, by French experiments. The process consists in transforming straw into a solid material having the resistance of oak. The straw is cut into small pieces and reduced to a paste by boiling. Certain chemicals are then added. When the paste has been reduced to a homogeneous mass, it is put into presses, and planks, beams, and moldings are readily made. The new material can be sawed like natural wood. It makes a good fuel, emitting little smoke. The statement that this artificial wood is especially adapted to the manufacture of match sticks makes the invention a particularly welcome one.

In Canada, according to the postal censor, food production values brought the largest returns, $377,000,000. But, if purely manufactured goods are considered, forest products take the highest rank with a total valuation of $197,000,000, of which $74,000,000 is for paper; while iron and steel products amounted to only $119,000,000.

The European war is responsible for the establishment of a new wood-using industry in Russia, namely, the manufacture of butter containers. Formerly the material for this purpose was imported chiefly from Germany, Austria, and Denmark, and reached considerable proportions, since the production of butter is an important industry in Russia and Siberia. The material was ordinarily imported in the form of barrel staves and bottoms packed with other things, particularly agricultural machinery, and was therefore usually secured quite cheaply even at considerable distances in the interior. Such imports were admitted free of duty in order to encourage the production of butter in Russia. When the outbreak of the war put a stop to these importations, attempts were made to manufacture

the butter containers out of Siberian birch, which did not, however, prove satisfactory because of the fact that it imparts some taste to the butter. Now the government is planning to produce the necessary material on a large scale from the extensive beech forests in the Caucasus. Beech constitutes approximately one-fourth of the stand in these forests, which previously had been used chiefly for supplying oil barrels, furniture materials, and railway ties. According to investigations by Professor Philipow both the white beech and red beech of the Caucasus are remarkably well suited for this purpose. Present prices for this material are now higher than prices formerly paid for imported material, but this is considered to be a temporary condition due mainly to lack of transportation facilities and to lack of men and horses during the war. It is hoped that beech from the Caucasus will be able to supply all of the needs of the Siberian butter producers and that private capital will interest itself in this new industry, which owes its establishment to the war.

In 1915 a new foresty journal, Espana Forestal, was started in Spain. A Spanish forestry association known as the Real Sociedad Española de las Amigos del Arbol (Royal Spanish Society of Friends of the Forest) had been established several years before under the patronage of the King and Queen. This society, which had previously published a yearly bulletin, now publishes also the new forestry journal. The journal is issued every other month and is attractively gotten up and well illustrated, with occasional colored photographs. It is devoted primarily to emphasizing the importance of forests in Spain and to attempting to arouse sentiment in favor of their preservation.

The United States Bureau of Plant Industry announces the prevalence of another imported tree disease which infects Italian poplars and cottonwood. It appears to be imported from France, where it was first discovered and described in 1884. In the United States it was first reported in 1915 from Massachusetts and New Hampshire, and is now found spread in small areas as far as Nebraska and New Mexico. The disease, caused by a fungus *(Dothichiza populea)*, resembles the chestnut blight in causing cankers or depressed areas in the bark which spread and girdle branch or trunk, killing the part above the canker, the trees becoming spike-topped. Especially nursery stock suffers, and it is from nurseries that it is spread.

Plantings of bamboo in northern Florida and Louisiana have grown to a height of 25 feet, and there is, according to the Forest Service, no longer any question about their producing in that country good canes comparable to those which they produce in China and Japan. Large enough quantities of young plants to set out many small areas throughout the South, from the Carolinas to California, wherever there is sufficient moisture and the land is not too high priced to admit of their cultivation, can now be supplied.

Forest investigations were undertaken in Denmark as early as 1882, when a special experimental department was founded under the department having charge of the state forests. In 1901 the work was extended by the establishment by the Board of Agriculture of the Experimental Forestry Service. The work is directed by a leader in conjunction with a commission consisting of two representatives of the Board of Commissioners of Woods and Forests, two representatives of private forestry, and one teacher of forestry. This commission meets at least once a year, adopts the plan of work to be carried out during the following year, and prepares a budget covering the work. The bulk of the investigations, especially those requiring continuity of work, are conducted by the leader, although projects may also be assigned to qualified specialists. Plans for the conduct of any experiment must be approved by the commission.

The appropriation for investigative work has risen from approximately $2,225 in 1902 to $3,750 in 1915. About 10 per cent of the total expenditures is used for permanent sample-plot work. The chief subjects of investigation are: Growth and yield; introduction of exotics; studies of forest soils; forest protection; races and forms of forest trees; reforestation, and methods of cutting.

In 1902 the Danish Experimental Forestry Service became a member of the International Association of Forest Experiment Stations and has been represented at the meetings of this association in Vienna in 1903, in Wurtemberg in 1906, and in Brussels in 1910.

S. M. Storm, a Danish forester who spent considerable time in this country several years ago, has published in the Journal of the Danish Experimental Forestry Service an interesting account of some experiments with foreign conifers on the island of Lolland, in the most southern part of Denmark. These experiments were started in

1889 by Mr. L. Jörgensen; who was interested in finding a quick-growing conifer that would give larger yields than Norway spruce and silver fir, and would also be better adapted to the stiff clay soil. Altogether 55 different species of conifers from various parts of the world were planted upon a sample plot of approximately 12 acres.

It is interesting to note that two species have so far shown themselves to be much better adapted to local conditions than any of the others. These are Douglas fir *(Pseudotsuga taxifolia)* of the coast variety and Japanese larch (*Larix leptolepis*). The Douglas fir has reached a maximum height of nearly 37 feet at 20 years of age and the Japanese larch a height of over 32 feet at 15 years of age. Douglas fir from the Rocky Mountains has grown so slowly that it is not considered to be worth experimenting with further. Sitka spruce has done very well, although not quite equal to the coast Douglas fir. Eastern white pine and jack pine have so far grown quite well, but the white pine has been severely attacked by the white pine blister rust. One other Japanese species, *Cryptomeria japonica,* is also promising, although it has been considerably exceeded in growth by Japanese larch.

The Forest Service of China, by the action of a new Minister of Agriculture and Commerce, in whose resort the service had been developing, has been abolished. Meanwhile, D. Y. Lin (Yale '14), whose propaganda work was in part reported in Forestry Quarterly, XIV, p. 471, continues to arouse interest in forestry, with the hope of reestablishing the service.

From the Quarterly News Letter of the Philippine Bureau of Forestry we learn that the lumber business of the islands is continually improving, so that mills are behind with orders, short of stocks for both local and export market, and are preparing for night work. All this is due to demands from China. Inadequate shipping facilities hamper the development of markets in India and Australia. Apitong railroad ties are particularly called for, without offers, the tie business, on account of the fact that inspection is made at point of delivery, rendering it difficult to carry it on profitably.

For one species at least, Lauan, the National Hardwood Association has adopted rules of grading, but these rules are said to be a failure, being not at all adapted to Philippine lumber; their only value is in advertising this substitute for mahogany.

The University of Washington has now obtained for its forestry department a demonstration forest, which lies in the Snoqualmie National Forest. It is proposed to have the advanced students go to this forest every year to get their actual experience in the timber. Students themselves will do the logging and study methods of transporting logs.

As forestry schools grow older and turn out an increasing number of graduates, it is of practical interest to keep track of the development of the latter by occasional *Who's Who* publications.

The University of Michigan Forester, published once each semester by the forestry club of the university, since 1912, in its latest issue brings such a list of its graduates on 29 pages, giving brief accounts of their accomplishments.

An expenditure of $10,000,000 for the purchase of additional forest preserves for the State of New York was voted at the last election. There is, of course, no economic thought behind this vote, the park idea being still uppermost in the minds of the promoters of this scheme. The New York State park comprises now 1,714,500 acres in the Adirondacks and Catskills, to which additions are to be made, besides spending $2,500,000 in the Highlands of the Hudson.

Basing their work upon the fact that the chestnut blight is an introduction from China and Japan, where, however, it appears not to be deadly to the native stock, the agents of the United States Department of Agriculture are engaged in producing blight-resistant chestnut trees for American use. Hybrids between Japanese chestnut and native chinquapin have been raised in considerable numbers. They quickly grow into handsome *dwarf* trees and bear profuse crops of excellent nuts ripening weeks before any other chestnuts.

While this is good news for orchard planting, it will hardly lead to reestablishment of our lost chestnut forests, the loss of which is estimated to entail between 60 and 100 million dollars.

REVIEWS

The Control of Damping-Off of Coniferous Seedlings. By C. Hartley and R. G. Pierce. Bulletin 453, U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry. Washington. 1917. Pp. 32.

This is an important piece of work, in so far as it seems to have come near demonstrating the possibility of combating successfully the damping-off disease, which is the bane of the conifer nursery. In the first place, the cause of the disease, which for a long time was wrapped in mystery, is chargeable to three parasitic fungi, *Pythium debaryanum* Hesse, *Fusarium moniliforme* Sheldon, and *Corticium vagum* B. & C. var. *solani* Burt; and other species may also be concerned.

The economic importance of controlling the disease is increased by the observation that often what losses are ascribed to poor germination per cent are really due to this disease.

While there are some nursery practices which have a limited value in reducing loss by the disease, such as the use of well-drained and aerated soil, cover with gravel, coarse sand, moderate watering and shading, the application of certain fertilizers, moderate density of sowing, and time of sowing, all of which receive attention, disinfection of the soil seems the only effective way of approaching the problem.

Experiments in seed-bed infection have been carried on for the last seven years at a number of nurseries, repeatedly in seven localities, and in fifteen locations in single seasons only. The materials experimented with were sulphuric acid, copper sulphate, zinc chloride, formaldehyde, tankage, air-slacked lime, cane sugar, mercuric chloride, charcoal. Altogether 115 tests were involved. These tests are correlated in a table and discussed in some detail. The work of other investigators is also briefly referred to. Sulphuric acid seems to have so far given the most satisfactory results, but must be carefully handled.

While costs of treatment vary considerably, the authors, from indications, conclude, that even if only 20 per cent increase in plants were secured, this minimum would pay for the treatment twice over.

Besides, secondary advantages are secured, in that germination is stimulated, the size of seedlings is increased, and weed control is assisted.

While these experiments are not conclusive, the authors attempt to suggest detailed treatments under different conditions, at least experimentally, and give the following summary of their own experiments:

1. By damping-off—the most serious difficulty encountered in raising coniferous seedlings—is meant the killing of very young seedlings by parasitic fungi.

2. To decrease losses from the disease excessive moisture and shade should be avoided, without inviting drought or white-spot injury to the base of the stem. Damping-off can often be decreased by putting beds on very sandy soil. Seed should not be sown any thicker than necessary. It appears better to sow broadcast than in drills. Late fall sowing results in decreased losses at some nurseries and is worth trial. Proper attention to all of these measures will decrease the losses from damping-off, but at most nurseries they are not sufficient really to control the disease.

3. The addition of lime, wood ashes, and, in some cases, nitrogenous fertilizers, seems to increase damping-off. Soil alkalinity appears to favor the disease. No effect has been noted from green manures. The use of unrotted stable manure has had very bad results; properly rotted manures seem less objectionable. Tankage, charcoal, and cane sugar are the only nondisinfectant substances which have to date given any hope of disease control.

4. Soil disinfection has so far proved the best method of combating damping-off. Of many methods tested, treatments with sulphuric acid, copper sulphate, zinc chloride, and formaldehyde have proved the most satisfactory. The disinfectants, however, behave quite differently at different nurseries. The acid has on the whole given the best results. Heat disinfection has been only partly effective. Disinfection by acid or copper sulphate is cheaper than by the other methods commonly recommended.

5. In addition to decreasing damping-off after the seedlings come up, the chemical disinfectants above mentioned, when properly used, cause an increase in the apparent germination and are very helpful in controlling weeds. This latter effect alone at some nurseries pays the entire expense of the treatment. Application of sulphuric acid has, furthermore, at some places resulted in marked increases in the late season growth of pines.

6. In some soils formaldehyde kills dormant seed, and the other three most satisfactory disinfectants at some nurseries kill the root tips of germinating seedlings. By proper precaution all such injury may be prevented.

7. The results obtained to date show that it is entirely possible and practicable to control damping-off by soil disinfection. Unfortunately, the varying behavior of disinfectants at different places renders it impossible to recommend any single treatment which will be everywhere successful.

Third Annual Report of the Botanical Office of the Province of British Columbia, 1915. By J. Davidson. Victoria, B. C. 1916. Pp. 81-150.

British Columbia, under the Minister of Education, has a department of botanical research and advancement of botanical knowledge in the schools, especially regarding the native flora and economic botany. This is done by correspondence with school teachers and others, evening classes and lectures, distributing school herbaria, seeds and cuttings, and by other means.

While this volume deals naturally with general flora, it is of interest to foresters of the Northwest, because it not only brings out ecological relations of the lower flora but also pays attention to forest conditions and economic forestry problems, such as finding plants fit to use in arresting erosion in the dry belt, and the introduction of hardy eucalypts.

A detailed account of an excursion into the Skagit River basin, which exhibits most varied geological features and typical vegetation of both dry belt and humid coast area, is interesting ecological reading, regarding plant associations.

Another account referring to the region of the Thompson River and a study of the changes in the flora of Dryas Island, due to changes in environment, will also prove of interest to those who work in the portion of the States adjoining this territory. The volume is well illustrated. B. E. F.

The Present and Future of Pennsylvania's Forests. By S. B. Elliott. Published by the Pennsylvania Conservation Commission. 1916. Pp. 28.

This is not a technical but a valuable propagandist article with some professional flavor in so far as it combats natural regeneration and argues preference for planting in the recovery of the cut-over forests of the Commonwealth. The reasoning is quite convincing, the usual arguments of the two schools of artificial and natural reforestation being presented with special reference to the physical condition of the forests to be recuperated.

As the article was prepared by a member of the State Forestry Reservation Commission, we had hoped to find more definite statistical information of conditions, but, besides a very general description, we find only a general estimate of the probable forest soil area as around 12,000,000 acres, somewhat less than 44 per cent of the total land area, 200,000 acres of which are set down as still virgin forest, and 70 per cent, say 9,000,000 acres, so devoid of uninjured trees of valuable species that it must be planted. And now, with the chestnut blight threatening the extinction of that most important species in Pennsylvania, still further acres are added of this description.

Mr. Elliott comes to the entirely sane position, that the recuperation must be by planting; that the State principally has to be relied upon to carry on this work, with possibly municipalities assisted, and private planters tax-assisted; but that the enormous burden should not be lightly undertaken; and, especially, that the State should not make any further purchases until an adequate work of recovery on the existing State lands has been done.

The State so far has spent in purchase and organization $4,625,000, and the Department of Forestry annually spends $300,000. A bond issue is suggested and the profitableness of the venture is asserted, largely on the basis of German experience and without attempt at figuring it.
B. E. F.

The Essentials of American Timber Law. By J. P. Kinney. Wiley & Sons, New York. 1917. Pp. 279 +x, 8°.

In organizing the curricula of two forest schools, the reviewer insisted that a forester, presumably destined to become a manager of property and business, should possess a knowledge of the essentials of business law in order to be able to interpret statutes and business

relations properly and to administer his charge with due regard to legal requirements.

Such courses are now in existence and more or less suitable textbooks have been prepared for them, like Huffcut's Elements of Business Law and Stevens' Elements of Mercantile Law. These volumes deal with the subject of business law in general. It was needful to have a book making special reference to the laws governing specifically the subjects with which the forester has to deal. The present volume, just from the press, fills this want. One would have expected that such a book would be written by a lawyer instead of a forester, but Mr. Kinney is not only a forester (M. F.), but has also the title LL.B., hence is particularly well equipped to undertake the task. It would take a similarly equipped person to review the book critically, and we hope to secure such a review later, but the importance of this unique addition to our American forestry literature made it desirable to give at least a full book notice at once.

No one who even glances through the volume can help being impressed with the thorough and painstaking manner in which the compilation has been done, citation of authorities, and of cases supporting every point made.

A very full table of contents and an index facilitates the use of the book.

Such a compilation does not call for much originality except in organizing the material and presenting it under logical arrangement. This has been well done in the eighteen chapters into which the book is divided.

The first two chapters define and classify general property conditions, specifying in the third chapter property in trees and timber. In this chapter the author might have taken it upon himself to point out where to improve existing nomenclature, for even judges might be taught better use of language.

The doctrine of waste is elucidated in three chapters; timber trespass in three chapters. Contracts referring to timber receive three chapters, taking care to quote the laws prevailing in the different States. Inspection and measurement of timber products are treated on twelve pages; the law referring to river driving on thirty pages. A chapter is given to the discussion of mortgages on timber; one on the law of boundary and highway trees; another to fixtures, as sawmills and nursery equipment; and the last chapter discusses the free use on public timberlands.

As the author says in the preface, while, of course, statutory law is subject to constant change, and can be ascertained only by reference to the latest statutes, the interpretations by courts are more stable and certainly the attitude of the courts which appears in adjudged cases can be traced most satisfactorily in this volume.

Wherever a course on business law is given to foresters, this volume will be needed to bring the examples illustrating the principles.

B. E. F.

Tree Wounds and Diseases: Their Prevention and Treatment. By A. D. Webster. J. B. Lippincott Company, Philadelphia; Williams and Norgate, London. 1916. Pp. 215.

Lippincott publishes in standard form, clear print, with wide spacing and good illustrations, this volume from the pen of an English author. In this country, which has lately been flooded with literature on the subject of tree surgery, the reason of the author for writing the book, because "no work of a similar kind has been published," can have reference only to the outward appearance. To be sure, besides the stock in trade of the tree surgeon, there is considerable discussion of pathological conditions, including fungus and insect attacks and injuries from animals, and advice how to meet them.

The physiological discussions are not always correct and complete enough even for a book of this more popular character.

In the prescription for treatment we have, in a superficial looking over the pages, found nothing essentially reprehensible nor anything specially new. The expositions are of common sense and simple character. New to the reviewer is a mixture of four parts sawdust with one part asphalt, to be used instead of concrete for filling, as being more elastic.

The subject matter is divided into thirteen chapters. A general discussion of policy in the management of decaying trees covers ten pages; the treatment of hollow trunks, seventeen pages. A rather long chapter of twenty-three pages discusses the supporting of heavy and diseased branches, which seems to be favored beyond desirable limits of preserving the decrepit. Bark injuries are treated on eleven pages. The chapter on pruning diseased trees is rather scantily treated on ten pages. It leaves out of consideration the proper pruning practice to prevent disease, and this is not even referred to in a later chapter on

preventing diseases. Some twenty pages discuss injurious influences from soil and atmosphere. Fungus growth on trees; insect attacks and their remedies; injuries from animals and birds; fruit trees and their enemies; accidents and diseases to which trees are liable; preservatives and materials, are the headings of other chapters, which reveal the lack of logical arrangement. The book is neither constructed on scientific lines, nor exhaustive of its subject; but it is, to be sure, a volume for amateurs, who may find many good suggestions in it. It is written in simple language, instructive and avoiding tedious details. B. E. F.

Farm Woodlot Timber: Its Uses and Principal Markets. By G. N. Lamb. Extension Bulletin 51, Purdue University, Department of Agricultural Extension, LaFayette, Indiana. 1916. Pp. 24.

This bulletin refers specifically to Indiana woodlots, of which there are over three and a third million acres, with a yearly product of $1.67 per acre.

The object of the bulletin is to enable the farmer to increase this return. Indiana is a hardwood forest State, only scrub pine and red cedar are the conifers among fifty or sixty commercially valuable broadleaf trees. The occurrence and use of these are discussed as well as the market conditions. Some of the information lacks in practical applicability, *e. g.,* a table of maximum and minimum prices for sawlogs at the mill gives for white oak $10 as minimum and $70 as maximum; for ash $12.50 and $50, etc., without giving a hint how the log grades run for various kinds parallel to these prices, except in general terms. An improvement in this respect is found in a table of veneer log prices, for which sixteen species are used, the cheaper for boxes and crates, the higher priced for furniture, where the size (diameter) is the price-maker, varying for the common hardwoods from $10 to $55. Discussions under the different kinds of wood bring out, however, what kind of logs are used for various manufactures and their relative values. It is pointed out that by selling graded logs one-third better price is secured than by selling at a common log price.

The unfortunate Doyle rule seems the established scale in use.

Fuel wood has an average farm value of $3.90, and in larger cities may go up to $6.85, while railroad ties bring from 30 to 65 cents, the

latter price for oak. Chestnut pole prices run from $1 for 20-foot to $6 and $8 for 55-foot. And so the various kinds of materials are discussed from the market point of view, and finally marketing suggestions are appended.

The object of the bulletin of informing the farmer of market conditions is undoubtedly successfully accomplished, but we regret that the opportunity of telling him how to use his woodlot silviculturally could not be improved at the same time. B. E. F.

Flat-headed Borers Affecting Forest Trees in the United States. By H. E. Burke. Bulletin 437, U. S. Department of Agriculture. Contribution from the Bureau of Entomology. Washington, D. C. 1917. Pp. 8.

The larger part of this bulletin is occupied with the structural features and systematic classification of these buprestid beetles; only a brief account of life history and habits in general is given, no suggestion of how to combat them; and the claim that these borers are "among the most important infesting forest trees in the United States" seems fortunately only a phase and hardly substantiated.

A Preliminary Report on the Occurrence of Western Red-Rot in Pinus Ponderosa. By W. H. Long. Bulletin 490, U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry. Washington, D. C. 1917. Pp. 8.

An old enemy, red-rot, newly defined, however, and as yet not named, is described as infesting *Pinus ponderosa* in Arizona and New Mexico over large areas. It is not *Trametes pini* with its woody, brown, perrennial fruiting bodies on the boles of standing trees, but forms annual fruiting bodies of white encrusting layers on the underside of logs lying on the ground. It attacks sapwood as well as heartwood of dead branches of living trees and from there travels down into the heartwood and gives no constant external sign of its presence. Since it does not frequently attack younger stock (blackjack), but is an old-age disease, of trees over 150 to 200 years old, the remedy is to cut these out.

Powder-Post Damage by Lyctus Beetles to Seasoned Hardwood. By A. D. Hopkins and T. E. Snyder. Farmers' Bulletin 778, U. S. Department of Agriculture. Contribution from the Bureau of Entomology. Washington, D. C. 1917. Pp. 20.

This bulletin describes the methods that have been found effective in preventing loss of seasoned hardwood products liable to attack by the powder-post beetles. The character and habits of these beetles are touched upon and the four species of Lyctus described.

Conditions favorable for attack are an accumulated stored stock of second-growth sapwood materials or refuse, and mixing species liable with less liable, when the latter will also be attacked. Sapwood seasoned for less than eight to ten months will not be attacked, and hardwood is never attacked.

Stock should be rehandled in November or February; refuse sapwood be burned; heartwood and sapwood, and species kept separate; the oldest stock utilized first; hardwood piling sticks be used; infested wood be removed; slightly infested be treated with kerosene, with brush or in vats, or with a mixture of kerosene and creosote; infested parts be cut away. A few other remedies for infested material are given.

Grass and Woodland Fires in Texas. By J. H. Foster. Bulletin 1, Department of Forestry, Agricultural and Mechanical College of Texas. College Station, Tex. 1916. Pp. 16.

Tree Planting Needed in Texas. By J. H. Foster and H. B. Krausz. Bulletin 2, Department of Forestry, Agricultural and Mechanical College of Texas. College Station, Tex. 1917. Pp. 32.

First Annual Report of the State Forester. By J. H. Foster, H. B. Krausz, and G. W. Johnson. Bulletin 4, Department of Forestry, Agricultural and Mechanical College of Texas. College Station, Tex. 1916. Pp. 16.

The profession will welcome these reports from the new State Forester of Texas, J. H. Foster. In his first publication he has rightly emphasized the fire problem, the laws governing Texas forest administration, and the need for tree planting. In "Grass and Woodland Fires in Texas" he describes the more serious fire problems, the damage resulting, and the possibility of future wood famine, if the forests are

managed on a permanent production basis. This is especially true in Texas, where lumbering is one of three great industries of the State, yielding over $20,000,000 annually to 25,000 wage-earners employed in 800 respective establishments. Besides the potential timber belt in Texas, there are vast areas covered by woodland, and according to Foster, "No one who has carefully studied the woodland fire problem in Texas can believe that fires should be entirely prevented." This raises the problem of light burning, which deserves more field study than it has received in the past.

In "The First Annual Report of the State Forester," Foster contrasts the meager Texas appropriation with that of other States having a smaller forest area. He also comments on Weeks' law cooperation, the examination of forest resources, the need of tree planting in central and western Texas, cooperation with cities, corporations and individuals, educational and experiment station activities, and plans for the future. According to this report, future work will be especially developed along the following lines: (1) Fire prevention in cooperation with the Government; (2) tree planting; (3) farm woodlots; (4) educational work; (5) investigative work; (6) cooperation in preparing working plans; (7) the establishment of State and National Forests in Texas. Evidently Mr. Foster will soon have his hands full if all these activities are to be pushed.

The bulletin entitled "Tree Planting Needed in Texas," by Foster and Krausz, is somewhat marred by a preface which seems unnecessarily picturesque. "Trees are the arms of Mother Earth lifted up in worship of her Maker. . . . The nesting places of love and song. . . . They entice sweethearts into leafy coverts to seal their vows with fond caresses. . . ." All of this may be true, but it seems rather out of place as a preface to "Tree Planting Needed in Texas." The body of the bulletin is chiefly a compilation from other sources, and is not presented as systematically as it should be. It is interesting to learn, however, that nurseries have already been established on several of the twelve experiment stations, and that "samples of stock will be distributed for further testing and observation."

T. S. W., Jr.

RECENT PUBLICATIONS

State Forestry Laws: Massachusetts. U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1917. Pp. 21.

The Pine Blister. By B. H. Paul. Bulletin 15, Conservation Commission, State of New York. Albany, N. Y. 1916. Pp. 18.

Nineteenth Annual Report of the Massachusetts Forestry Association. Bulletin 119. Boston, Mass. 1916. Pp. 48.

Lupines as Poisonous Plants. By C. D. Marsh and A. B. Clawson. Bulletin 405, U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry and the Bureau of Animal Industry. Washington, D. C. 1916. Pp. 218.

Sixth Annual Report of the New Hampshire State Tax Commission, 1916. Concord, N. H. 1916. Pp. 212.

The Hardwood Distillation Industry in New York. By N. C. Brown. Technical Publication No. 5 of the New York State College of Forestry. Wood Utilization Series No. 1. Syracuse, N. Y. 1917. Pp. 66.

Sugar Pine. By L. T. Larsen and T. D. Woodbury. Bulletin 426, U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1916. Pp. 40.

The Hardwood Distillation Industry in New York. By N. C. Brown. Technical Bulletin No. 5 of New York State College of Forestry. Wood Utilization Series, No. 1. Syracuse. January, 1917. Pp. 66. Illus.

The author briefly reviews the early history of the industry and its development in the State. Considerable attention is given to a discussion of the methods of manufacture, costs of operation, yields, market value of the products, and uses to which they are put. Similar reports in other forest industries in the State would be gladly welcomed.

Tree Planting Needed in Texas. By J. H. Foster and H. B. Krausz. Bulletin of Agricultural and Mechanical College of Texas. Vol. 3, No. 1. Bulletin 2, Department of Forestry. January 10, 1917. Pp. 34. Illus.

A discussion of the need of planting, species to use and methods to be pursued in planting and caring for them.

The Forests of Worcester County. By H. O. Cook. Office of Massachusetts State Forester. Boston. 1917. Pp. 88. Illus.

The results of a forest survey of the 59 towns in the county and a study of the local lumber industry.

Annual Reports, Washington State Forester to the State Board of Forest Commissioners. For the years ending November 30, 1915, and November 15, 1916. Olympia. December, 1916. Pp. 41. Illus.

Diseases of Forest and Shade Trees. By D. C. Babcock. Monthly Bulletin of the Ohio Agricultural Experiment Station. Vol. 1, No. 10. October, 1916. Pp. 291–339. Illus.

A Manual of Standard Wood Construction. Southern Pine Association. New Orleans. 1917. Pp. 127. Illus. Fourth edition. Price $1.

A valuable manual for those interested in the use of southern yellow pine for construction purposes.

The Sandalwoods of Hawaii—A Revision of the Hawaiian Species of the Genus Santalum. By J. F. Rock. Territory of Hawaii, Board of Agriculture and Forestry. Botanical Bulletin 3. Honolulu. 1916. Pp. 43.

This bulletin contains a brief history of the sandalwood trade in the islands, a discussion of the Hawaiian species of the genus Santalum, results of a chemical analysis of the oil of *Santalum freycinetianum* Gaud., and a key to the Hawaiian species of Santalum.

PERIODICAL LITERATURE

Forestry in Great Britain

Forestry in Great Britain, as pointed out in Forestry Quarterly, XIV, p. 766, has made little progress under the development commission. An attempt was made lately to revive interest by the English Arboricultural Society. After a very lively discussion at its meeting in September, 1916, the society rejected some other radical resolutions to be submitted to the government, calling for a separate government authority or department responsible to Parliament as an essential step; for a survey and land classification with a view of afforestation through demobilized soldiers; for restricting private deforestation and enforcing immediate reforestation of cut areas, with or without state aid, or forcible dispossession; for extinction of servitudes and improved management on state forests; for a large scheme of reforestation of waste lands to be purchased by the state—a program worthy of a Colbert!

These resolutions were presented by Professor Somerville, who accompanied them by lengthy arguments.

He showed that the small forest area of Great Britain had shrunk by 37,000 acres in eight years before the war (and it is shrinking more rapidly now!), while there are now nearly 20,000,000 acres of mountain and heath land of which at least 6,000,000 lend themselves to timber-growing. While 10,000,000 loads is the import of wood from countries climatically similarly situated, the home production is only 1,000,000 loads.

The society, however, voted delay.

Discussion on the Present Position and Future Development of Forestry in England and Wales. Quarterly Journal of Forestry, January, 1917, pp. 20–58.

Large-size Trees

An interesting note comes from Switzerland on some large specimens of old Norway spruce (or is it fir? the Journal calls them *épicae* and *sapin* interchangeably!) which had been preserved by the commune of Tourtemagne for their interest to visitors, but were cut to secure the unusual price which the war has brought about.

The trees were about 350 years old, the wood very fine-grained.

One of them measured around 400 cubic feet, 140 feet in length. (This may furnish in the neighborhood of 3,000 feet b. m.) The net return to the commune for the twenty-nine trees was a little more than $2,000, or, say, $70 per tree and 24 cents per cubic foot in the log; and, since the cutting cost 2 1/3 cents, this may be translated into around $26 per M feet stumpage. Transport and other charges increased the cost to the purchaser on board cars to nearly 50 per cent more.

Journal Forestier Suisse, January, 1917, p. 12

Douglas Fir on Limestone

Contradicting his former opinions, Professor Somerville, of Oxford, reports a series of observations, accompanied by soil analyses, showing the adaptation of Douglas fir to limestone soils. "It would appear that the species may be planted with confidence on soils overlying chalk, provided the top 12 inches or so is thoroughly disintegrated, and especially if a previous crop of hardwoods or underwood has left the surface rich in humus." It grows even quite satisfactorily—at least for eight to ten years—with chalk found at a depth of six inches.

Even where solid rock occurs within two feet of the surface, the author would recommend the planting of Douglas fir.

We may add that probably not the chemical constitution of lime soils, but the geological formation, which in limestone is often a horizontal layering, and the lack of fissures for water and deep-going roots to penetrate may account for the observed lack of success on limestone soils by certain species (chestnut).

Relationship of Douglas Fir to Lime in Soil. Quarterly Journal of Forestry, January, 1917, pp. 1–6.

Swiss Forestry in War Time

In a brief note Schönberger points out that during the war much more wood is cut in Switzerland than the increment, for instead of an imported deficiency in 1913 of about $7,000,000 worth, for 1915 an excess of nearly $2,000,000 worth is recorded, *i. e.*, a difference of $9,000,000. Yet to secure the requirements of paper mills the government threatened forcible

measures in addition to the considerable higher prices instituted by legislation, besides partial restriction of wood export. Owners, more or less in debt, have taken advantage of the high prices and over-cut and the danger of continued overcutting is pointed out.

To alleviate these dangers, acquisition of public forest, federal or cantonal, and reforestation is suggested, which would be easier now than in peace time, when also a larger product per acre would result, for it is notorious that private forests in Switzerland produce fully 15 cubic feet less in the average than public forests. Besides, the cultural influences of forest cover could in that way be better attained.

Eine gute Gelegenheit. Schweizerische Zeitschrift für Forstwesen, November-December, 1916, pp. 229–31.

Combating White Pine Blister Rust

In a paper before the Canadian Forestry Association, Dr. H. T. Güssow, Dominion Botanist, combats the idea of Mr. Rane, State Forester of Massachusetts, "to go ahead planting white pine as enthusiastically as ever, leaving the problem of its protection to be looked after by technically trained officials." The author wisely suggests stopping further planting and increase of host plants until the disease is controlled, especially since so far the only control known is eradication of diseased trees and diseased Ribes. By these means perhaps the disease may be brought under control and the sooner the eradication is done the better.

In discussing the life history of the rust, the author points out that decisive symptoms of infection may not become visible for a year or two. Hence during this period of incubation it is difficult to diagnose the disease; and in transplants this incubation may be still further continued, so that for some years the infection remains unobserved. Old trees which are not killed, but lose only branches, serve for years as harborers of the disease, acting as propagators.

Periodical inspection and removal of diseased trees has been found more expensive and less effective than destruction of the whole infected plantation and replacement by healthy plants.

The author points out that, while at present the disease in Canada is mainly confined to the Niagara district, and can perhaps be controlled by watching distribution of affected material, the problem would become more complex if the northern pineries became infested.

Finally, the only hope for control lies in the fact that the disease to propagate itself requires the intermediary host of Ribes. The part this host plays in propagation of the disease is elucidated, and it is shown that some important points are still undecided, such as the wintering of the rust on currant and gooseberry bushes and the length of time that spores remain viable; but enough experience has been had to warrant the propriety of preventing shipments of these plants.

The author then formulates twelve propositions of control as follows:

1. Exclusion of all foreign white and other five-leaved pines (which has already been done).
2. Exclusion of all foreign species of the genus Ribes according to Gray's Manual, if known to be carriers of the rust (which has already been done by the United States).
3. Examination in plantations, hedges, shelter belts, etc., of all white pines originating from any foreign sources.
4. Destruction in any such plantation, hedge, shelter belt, etc., of each and every tree found infected even in the smallest degree.
5. Examination of Ribes, wild or cultivated, in the neighborhood where infected pines may be found; if disease be found, the area should be proclaimed as a danger area.
6. Systematic lookout, during April, May, and June, for blister rust on native pines; and from June to October for currant rust, followed by immediate report and proclamation as danger areas, wherever disease be found.
7. Strict quarantine against the export of white pine or other five-leaved pines from any danger area.
8. Strict quarantine against the export of currant or gooseberry stock from nurseries in any danger area, until a license has been granted by an authorized government official that neither stage of the rust has occurred on the premises of the licensee, while, at the same time, all pines have been destroyed throughout the danger area.
9. Destruction of all wild species of Ribes acting as carriers in the neighborhood of valuable standing white pine timber.
10. Planting of deciduous tree shelter belts surrounding new pine plantations.
11. Mixed forestation.
12. Raising of pine seedlings for future supplies from home-grown seed outside of danger areas.

The Control of the White Pine Blister Rust. Canadian Forestry Journal, January, 1917.

Lumber Making in Chile

Mr. Alfred Bauderet, of Cura Cautin, Chile, a lumber and shingle manufacturer, says there are 3,000 small sawmills in Chile, operated mainly by farmers. These mills run chiefly between October and January when they suspend operations for the harvest. There are a few large mills of American make which run when market conditions warrant.

Labor is one of the great problems in the lumber industry in Chile, because of the numerous feast days which consume on an average of three days per week. Wages average from 50 cents to $1 per day. Mr. Bauderet was the first one to introduce the wooden shingle in Chile, and even now after some years it is not always easy to effect sales, since the high labor cost of properly laying shingles enables galvanized roofing to offer strong competition.

There are no standard grading rules for lumber and much annoyance and often financial loss results from misunderstandings about grades. Native species at the shipping point bring from $12 to $25 per M board feet.

Timberman, January, 1917, p. 46.

Cost Accounting in Hardwood Lumber

One of the weak sides of the lumber business has been its accounting methods, a fact long recognized by the leaders of the industry. The subject has been under discussion at lumber trade association meetings for some years and prominent notice has again been given the matter by recent utterances of the Federal Trade Commission and in the recent report of the U. S. Forest Service on the lumber industry.

Of interest in this connection is a recent article from the cost committee of the Gum Manufacturers' Association, some members of which have on previous occasions contributed illuminating articles on the subject of lumber accounting.

The committee states that "the cost of installing and maintaining a cost system should be considered just as much an investment on which a fair return is to be expected as in the case when improved machinery is installed to take the place of old, worn-out, or out-of-date machinery."

The committee recommends a cost system departmentized as fol-

lows: stumpage, logging, manufacturing, yarding, sales, shipping, and overhead.

It is recommended that separate costs be kept for each kind of wood, in order that where several species are handled, it may be determined readily as to the difference in costs of manufacturing each one. This is one of the vital phases of hardwood cost accounting.

The method suggested for arriving at a fair division of the time element is to time the production of the different kinds of lumber through the mill for a given period and then take the cost per hour of the plant and determine the percentage of cost of each different kind of wood during a certain period of operation. This division of cost the committee would carry through on both manufacture and sale, so that the profit or loss on a given species could be determined.

The article discusses the subdivision of the main accounts into their proper heads and there is also submitted a blank form showing the suggested arrangement of the cost sheet.

American Lumberman, January, 27, pp. 38–39.

PERSONAL NOTES

Personal notes by regions will be printed from now on only every three months. They will appear as far as possible in the issues for January, April, June, and October.

John D. Gilmour, formerly with the forest branch of the Departments of Lands of the Province of British Columbia, is now filling the position of general logging superintendent of the Anglo-Newfoundland Development Company, Limited, a branch of the Harmsworth Company, owners and operators of immense pulpwood holdings in Newfoundland. Mr. Gilmour is a graduate of the faculty of forestry of the University of Toronto and also of the Agricultural College of Ontario.

SOCIETY AFFAIRS

By a majority vote the executive council of the Society has favorably acted upon the three propositions submitted to it by the Washington Section regarding the place of the forest profession in national defense:

(1) That the council formally indorse for the Society of American Foresters the action proposed by the Washington Section, subject to the understanding that the action involved on the part of individual members shall be entirely voluntary and that the work may be correlated as it is found desirable with other like activities.

(2) That the executive council appoint the identical committee selected by the Washington Section to act for the entire Society in this matter.

(3) That the executive council allot to this committee from general Society funds the sum of $25 to defray expenses incident to the work.

A meeting of the California Section of the Society of American Foresters was held Friday, February 9, at which Mr. Stewart Edward White was present. The program of the evening was "Fire Protection and Insect Control."

CONTENTS

Vol. XV MARCH, 1917 No. 3

JOURNAL OF FORESTRY

OFFICIAL ORGAN OF THE SOCIETY
OF AMERICAN FORESTERS

COMBINING THE PROCEEDINGS OF THE SOCIETY AND THE FORESTRY QUARTERLY

PUBLISHED BY THE
SOCIETY OF AMERICAN FORESTERS
At 930 F STREET N. W.
Washington, D. C.

Single Copies, 50 Cents Annual Subscription, $3.00

Application for entry as second-class matter pending.

JOURNAL OF FORESTRY

A professional journal devoted to all branches of forestry

EDITED BY THE EDITORIAL BOARD OF
THE SOCIETY OF AMERICAN FORESTERS

The Journal appears eight times a year—monthly with the exception of July, August, September, and October.

The pages of the Journal are open to members and non-members of the Society.

Manuscripts intended for publication should be sent to Prof. B E. Fernow, at the University of Toronto, Toronto, Canada, or to any member of the Editorial Board.

Subscriptions and other business matters may be addressed to the Journal of Forestry, Atlantic Building, 930 F Street N. W. Washington, D. C.

JOURNAL OF FORESTRY

Vol. XV | MARCH, 1917 | No. 3

HOW LUMBERMEN IN FOLLOWING THEIR OWN INTERESTS HAVE SERVED THE PUBLIC[1]

By Austin Cary

Logging Engineer, Forest Service

As Government employes, and back of that from our educational history, most of us are to some extent separated from the run of our countrymen. We are in a friendly organization; the pay check comes regularly; a type of mind that is not the most common one caused us to gravitate here. This might lead to one-sided development and lack of appreciation of outside things and the life of the common man. The scramble of ordinary American life might, in fact, get to look unattractive and sordid. I do not assert the fact, but I say there is that possibility. And if such a thing should come to pass the result would be bad, for the duty incumbent on men in our position, the thing we are here for, is to serve the public.

There are other men here who in times past have engaged in this common scramble. I think they would all say that they think it was a good thing—that in connection with and for its bearings on their present work they value the experience. Not many besides myself, however, have had prolonged experience in the lumber industry, and because our own business touches that at so many points, and because its representatives and we deal with the same elements and interests, I have thought some discussion of that and its relation to the things in which we are peculiarly interested, based on my own experience and the insight so derived, might be more serviceable than a technical paper.

The first point I will take up is the democracy of the industry. It may be that I shall idealize here, for it is true that my own experience has hardly been representative. That was in New England

[1]Delivered before the Society, February 10, 1916.

mainly, where lumbering started as one standard activity of the old New England stock, and still continues so in large measure. My own uncles, in fact, were lumbermen, and I can remember being in their camps before stoves were used, when the fire for warmth and cooking was in the middle of the camp under a big smoke hole, while the berth and living space were under the eaves. Then, too, lumbering in New England remains yet on a moderate scale and is largely worked, or was a few years ago, by native and provincial labor. Democracy was certainly a feature there, however. It was also in the Lake States when lumbering was the great and characteristic industry, and to my knowledge the same is true in large measure in the Northwest today.

The conditions of the life no doubt have much to do with that. When men face cold, rough living, and hard labor together, less elemental things count for less in comparison, and man gets to man in the primeval, direct fashion. At any rate I possess that feeling about lumbering. I prize it, and I want to give you a recent and prominent illustration.

Last winter, as a matter of mental improvement, I read a book called "The Job, the Man, the Boss." This book is supposed to be up to the minute in the way of scientific management and business organization. One thing in it particularly stuck in my mind—what was described as the last reliance of a manager in getting his work done. With pay suitably arranged, conditions of work looked after, selection of men made according to adaptability, and all the other schemes of modern management employed, there still would arise situations of unusual difficulty, sharp pinches to get over, which the scheme could not undertake certainly to provide for. And the book said that at these times the best reliance, a thing that would sometimes do the work when all else failed, was the personal liking of the men for the manager.

That, I suppose, is good doctrine in a scientific way; I am willing at any rate to take the book for it. Soon after I read it I was reminded of the matter in another connection. It was at a meeting of the Forestry Club of the University of Washington at which the chief address was made by Mr. George S. Long, manager of the Weyerhaeuser Timber Company. Mr. Long holds a big executive position now, but he grew up in the lumber business of Wisconsin and worked through every part of it. His main theme that evening

was to tell the students how, if they ever had a lumber business to manage, he would advise their going at it. And strange to say, the whole burden of his talk was on the very point above mentioned. He told the fellows that the chief element in their success would be to have the men like them. Not the kind of job altogether, or the conditions of work, or the pay—but, *do they like you?* If they do they will work with heart, and when a pinch comes will jump into the collar and take the load over.

I believe that has been true in very large measure of American lumbering, particularly of the logging branch of it. I wish it might always be true in industry, for relations of that kind between men either settle or stifle a good many possible questions.

Second of the points I want to take up is the discipline of industry. I have heard intellectual men talk in a disparaging way of business, and perhaps in my younger days rather looked down on it myself; but if so, experience has led me to look at it differently. What I mean in the first place, I can bring out sharply by contrast. One of the biggest disappointments I ever had in my life came in connection with an early service I had on a college faculty. I had of course had experience of student consultations and debates, and I had ideals of thoroughness and business-like procedure that were different. One of the rewards of being a member of a college faculty I thought would be to see business done like business. The disappointment I had I cannot measure.

Years later, and yet years ago, I had experience of the reverse character. I was working for a first-class business concern and had occasion, in connection with buying timber property, to be for a considerable time with the heads of it and see them go over some propositions of consequence. That was what I had been looking for. From point to point they went, making sure of each one. The promising or plausible wouldn't do. All the facts had got to be clear, to be weighed, and that the thing was sound and right had got to be demonstrated. Otherwise, as they well knew, there was a good chance of failure. I am glad I had the sense to see the matter on the intellectual as well as the money side, and in some degree to profit by the experience. Since then my eyes have been opened. We know that business today attracts many of the ablest and strongest in this country, and, as I see it, those men congregate to it in part because of the vigor and test of it—in other words, they crave as well to

make good as to make money. In fact I know of no other field in which men are held to so strict accountability.

And there is moral discipline involved, too. I well remember the saying of one of the men above mentioned, to the effect that every employe has his strong and his weak points, but all that has to be evened up in a general measure of serviceability; and the manager's task is to preserve that and, if possible, increase it. In that way, not by hiring and firing, business progresses soundly.

That involves moral restraint, subjecting small matters to the main end, putting up with disagreeable things oftentimes; and I say that last with particular confidence because I came to see how my old employers had put up with a lot from me.

Let me illustrate again. In 1898 I went to work as forester for one of the big lumber and paper manufacturing companies of New England. One main branch of my job was to circulate round through the camps in the cutting season to see that the timber was well picked up; also that the land was cut conservatively. The story turns on the fact that for a considerable time we cut too conservatively in places and had a loss from it.

I never shall forget the circumstances. After long soaking rains in December of 1900 a big gale came on and blew down lots of timber. I was in the woods at the time, heard the trees cracking as they went over, and was sick enough, I tell you. Most men would have quit the job if they didn't get fired. As soon as it quieted down so a man could travel I looked the country over to see how things were, and when Brown came into the woods next I was ready for him. It was his money lying on the ground, mind you, not mine; and this is what he said after we had talked things over: "I feel that we were right in our main policy in spite of this; and we are going on with it. If we have made any mistake we shan't make the same mistake again." It took me a long time to size that up in all its bearings, but you can see at a glance that it was staying with a man; and I stayed with him, too, as long as there was any point to it.

Nor in speaking of the leaders do I neglect the common men. Of these the foremen, scalers, and cruisers are the best representatives. Their loyalty for one thing is traditional. In that connection there comes to my mind the statement of a writer on the timber-bond business to the effect that cruisers have sometimes been so loyal to "the old man" that they would lie for him. That may have happened; I shouldn't wonder; but however it may be, I prize

recollections of old associates for things in this line that did not involve infidelity in any direction. The foreman struggling to keep liquor out of his camp, the scaler maintaining his integrity against all comers, the cruiser working day after day with no man's eye on him—nowhere will you find finer examples of competence, loyalty, and courage than among these classes. Physical ruggedness, of course, went along with it that was ready for any hardship. Twenty-five years from now it won't be believed that there ever were such men as the old New England and Lake States lumbermen.

Of course I know there's another side to all of this. I have, in fact, suggested it; but the useful thing, I take it, oftentimes is to a certain extent to idealize. It is worth while, and desirable in this case, to see the good points in a class of our fellow-citizens. What I believe myself is that lumbermen have contributed a distinct and valuable element to what President Wilson has been calling the "spiritual capital" of this country.

The third point I wish to emphasize is the necessity, the indispensableness of industry, and here again I can enter the subject best from a personal reminiscence. On one of those expeditions I spoke of at the start, I remember our noticing the scarcity of local help to properly man a contemplated enterprise. "That's all right," said one of the men along. "That will take care of itself. There is never any trouble but that when you get to doing business men will come to you." And that, when you think of it, is a very significant thing. The fact is, men must work to live—it is a part of the law laid down for mankind at the start—and man's forebears, too, had to do what represented it. Work not only supplies the necessities of life, but it fulfils the necessity of our natures, and in these times men without that particular capacity flock to the one who has the genius of organization for production.

And if industry is good every way for the worker, no less are its products necessary for society, and in fact, looked at one way, society in relation to any one industry is only the balance of the workers massed together. And wealth, the accumulation or surplus of industry, is good for some things, too. One thing it does is to maintain us here in our places.

Last in this branch of the address I think I will venture to mention a matter that might in some companies cause disagreement and contention—the present form and organization of industry. I

do not mean to disparage imagination constructively used or to discourage any man's genuine efforts to make the world better, but I do object to half-baked propaganda that sees only one set of facts, and I feel that reformers, like business men, ought to go carefully and hunt for all essentials. I am thinking now especially of wage labor, and how it fits men, or most of them. The majority of men want an assured job. Beyond certain limits security is of more consequence than the amount of the compensation. Risk, organization, invention, are out of their line. On the other hand, these elements in industrial life when supplied by others render their labor more productive, and they share in the benefit. Now, on the other hand, there are men who are only at ease, and who are most fruitful, when they are furnishing the above elements. In fact, their energy might be dangerous if it hadn't such outlet.

This is out of the main line of all of us and I am going to cut it off with reference to just two things that come to me from recent experience.

First. We talk about fortunes too great for the good of their possessors and of society. I think that not so long ago I saw a class of wage workers that, judged by the same standards, was paid too high wages.

Second. Organized labor having been beaten in the shingle business in the Northwest some months ago, turned to cooperative manufacture and planned, through allied unions in the East, to build up a market for the product. This looked like a splendid, progressive plan, a chance for labor to get what it has sometimes claimed as its due, all there is in an industry—and conditions in that industry seemed favorable. A good deal could be brought out here, but I will refer to but one aspect of the matter. That is, that upon inquiry it developed that the union's purpose was, when it had got the scheme going and had built up a market, to give up the cooperative feature of it and use the advantage gained in a trade for union conditions with the old employers. That was a disappointment to me, but the fact is there, and it is certainly significant.

It brings this matter of labor a step further, where we shall want it later, if I mention here a thing that greatly pleased me in the recent presentation of the lumber industry before the Federal Trade Commission. At the Chicago hearing in July, Mr. Goodman of Wisconsin stepped aside from the main lines of the hearing, showed the

commissioners some pictures, and told them about his workmen and their families at Goodman. And he told it in such a way that one could almost see those people. Prosperous industry in the abstract has a metallic sound; in fact, the idea of buncombe may easily associate with talk of it. But a settlement of good Americans or Province men or Scandinavians about a sawmill and working in the woods for a sound concern that is doing well enough itself and uses them liberally—hardly any picture can be called to mind that should be more attractive. As for the particular enterprise I have referred to, while I never saw it, I would bet something that a man coming in from outside, of whatever stripe he might be, would find it slow work undermining the men's confidence in their employer.

Now I have finished that part of this address which is entirely disconnected from technical subjects, and it would probably seem detached from the rest and a gratuitous imposition of notions irrelevant to the whole field of the Society if I didn't make one or two clear connections. Perhaps it will seem so anyway.

Of these connections the first is that these woods on the American continent are for the use of the people. Of course, we ought to be decent and appreciative in this use, and as honest men we will want future generations to share in the benefit; but use is the key for each generation as it goes along and in respect to the things it requires.

Second, cross-cutting the matter at any one time, the American public is interested in these woods and forest lands in two ways—on one side as participating in the ownership of the utilities involved, present and future; on the other side as consumer of forest products currently.

Third, we have got to handle all the matters involved in accordance with our own genius as a people—our knowledge, our training, and our capacity. Of that there may be much latent in us that will in time come out; in fact, it looks as if such things were now developing. But what we have done well, what we know we can do, what in fact we are famous for among the peoples of the earth, is to manage things by way of individual enterprise and invention. This continent was conquered and civilized not under the direction of a despot or by a carefully planned system, but through individual initiative, by the push and energy of a free people. The people led and government followed. When an opportunity has arisen or a gap has appeared, the usual course has been for the energy and invention of some man or

group of men to step into it. With that much behind, I mean to trace relations with some things in which as foresters we are particularly interested. I will indicate in advance so much of personal position as to say that I think this push and energy of our people on the whole has been not only resultful, but pretty wise also. And believing that, one looks for adaptation to new conditions as well, though not necessarily with great rapidity. Whatever, for instance, we ourselves have to urge in the way of collective effort or otherwise, will be measured, and ought to be measured, by that same wisdom.

I see no better way to get into my next subject than by starting with topics presented by Mr. Kellogg in the paper you have just listened to. Two topics stand out in it—lumber grading and better merchandizing of lumber. Mr. Kellogg treated these things from the producer's point of view—he calls it lumbermen helping themselves; but to me another side is no less evident, that lumbermen in thus helping themselves in these matters are also serving the public. What, for instance, does lumber grading mean if not more specialized, economical, and effective use of lumber? That is to say, as timber becomes less abundant relatively, which had to be anyway, it is classified so as to serve varied purposes more economically. This, as I see it, is true conservation; in fact I do not see anything that touches that matter on a larger scale or more effectively. And the industry has spontaneously and without cost done the public this service, following its own interest under the working of economic forces.

In connection with the merchandizing pressure that he speaks of I was led to think of a recent extension in the use of lumber largely promoted by exactly that influence. The silo, as I understand it, is a most valuable aid to agriculture; farmers and their friends have taught its utility and extended its use; but a potent force for that extension of late has been, as I understand it, merchandizing pressure from western producers of lumber, trying fundamentally to get out from under timber investments. That I look on as useful work, and again, the industry furnishes it gratuitously. Further, as Mr. Kellogg indicates, much more of the same kind is coming. It seems clear, in fact, that as a result of the recent depression in lumber and the reaction of lumbermen from it, the people of the United States are going in the next ten years to be served with lumber as they never were before—in more variety, better fitted to use, cheaper relatively to the difficulty of furnishing it. Now if we value service of this sort, as I think we

all do, let us give the credit where it belongs, to economic forces, to the productive energy of the lumber industry. And don't let us blacken that with a purely selfish motive either. Although financial success is at the center of it there is a lot more to it, as I have tried to explain. The point may be clearer if we try to imagine what things would be like should the motive go out of business men and production cease. How would it be either for labor or the consumer?

Utilization is a matter that touches us closely, and now we have touched on the borders of it we may well follow it a little further. Some years ago numerous men of our persuasion had the habit of idealizing European standards in this matter. We seem to have got over that and, if only they are on the level of sound economics, to be satisfied with current standards and practices, though I don't remember anybody saying just why. In thinking over these matters I get myself the clearest conception from primitive conditions, when the country was all woods and men went direct to the source of supply and took what they required. Their rule, as near as I know, was to satisfy their need with the least sufficient effort and that looks like a sensible rule. Now with an organized industry the *price* tells the same story, for that measures what in the way of his own effort or product the consumer will exchange for the commodity. But with prices of forest products rising, as they did and as looks inevitable in the conditions, closeness of use and specialization have also gained, and through that means, as it seems to me, there is fulfilled the law just mentioned, of need supplied with the least sufficient effort; also economy gains with advance upon the stock of our resources.

Now I am not going to claim perfection for our commercial, capitalistic system or for the lumber industry, but I ask you to consider broadly and fairly how utility and price on the one hand, and on the other completeness and intensification of use, have worked together, especially to consider how substitutes for lumber have appeared in late years on the recent price levels, and then ask yourselves if in the main these economic forces are not sound and serviceable, if on the whole they have not greatly served this country, if in fact you really think that centralized, designed control could on the whole and up to date have provided us with any better system.

Before I leave this topic of utilization I want to offer an illustration of individual interest running parallel with the general interest from the field of stumpage ownership. Here, in the first place, let us

not forget that with value comes inducement to protect, and that that is now having abundant illustration. But the fact I had especially in mind to point out is that really shrewd and strong timbermen, in the treatment of an investment, have had the rule to hold it until its main resources represent considerable stumpage value, and then to cut. Now that rule, as all should know, means better utilization than if the property is cut on a low valuation. Here again economic forces line up broadly with the general interest represented in utilization. They operate automatically and on a large scale, too.

These may be new ideas to many. They are not in fact so familiar to me that I feel sure of making all due and necessary qualifications. For there are qualifications—we may be sure of that before we recognize them. To be fair I will say right here that I believe myself there are utilities that are without value in the commercial sense that do need protecting. Not that everything can be claimed under that, however.

I find that Mr. Zon is turning over in his mind the line of thought which I shall next take up, and as he is a persistent and candid man he can be relied on, before he gets through, to do the matter justice. I will therefore deal with it but briefly. I refer to the fact that lumbermen in following their own interests in woods operation have often practiced good forestry—not seldom better in fact, when the results were all in, than that proposed by the foresters. Here grace will lead me to start with my own work and I do that gladly. Perhaps, indeed, you will say that the simple, unpretending work done in the years of service with my old company was not forestry, that minor gains in utilization and bringing the work of 500 men a trifle nearer to ideals in respect to reproduction and growing stock, was not fit employment for a member of the profession. Some thought that at the time anyway, but times have changed now, and assuming the point, what I have further to say is that, as I now see it, the good sense of my employers pointed by their self-interest contributed a safeguarding element that was essential to success, while to the system finally settled on the loggers' ideas were nearer than those of the forester—that is to say they had at the start a nearer appreciation than I of the considerations which had to govern.

I could bring from the same region, that with which I am most familiar and from all stages of its history, many other illustrations of lumbering practice working out as good forestry, and some of forestry principles applied to lumbering in a practically successful way. Confining

myself to noting the broad fact that around the southwest angle of Maine, the point where in 1630 lumbering on a commercial scale on this continent had very nearly its beginning, a thriving and sustained business in lumber is done today, I will pass on, and in this field take up but two more illustrations, both of which have been developed in recent meetings of this Society.

Mr. Eldredge, the other evening, gave a very interesting account of conditions in Florida. He said the native forest looked like a hard proposition for the forester—it was dry, there was no reproduction, it seemed like a hopeless proposition to regenerate it. Then he told of the wonderful natural protection of the pine seedlings of which we all know, and said that for miles and miles in that country (I really gathered the idea that it was a general condition) after the lumbermen had taken all they wanted from the forests, knocked them all to pieces and let the fires run without hindrance, there was full pine reproduction.

Third, the relation of larch and pine in the National Forests of the Inland Empire has been mentioned at these meetings. The history I understand to be that after several years' trial and experiment along lines suggested by forestry theory it was concluded at the finish that the practice of lumbermen on their own lands, following their own immediate interest, was very close to the true line of practice, silvically, financially, and every other way. Two things are involved here—first, that lumbermen had a sound understanding of timber economics and values; second, that their practice proved to be good silviculture.

The principle involved here could be given much wider illustration, but for the present purpose clear formulation of the idea will be sufficient. I don't, of course, mean to say that things always work that way, that study of such things is useless, or that designed control is not necessary in some cases. The practical upshot of what I have meant to say was stated in an address I made in British Columbia last winter—that a practice found in actual lumbering is pretty liable to be good forestry in the long run and should not be disturbed unless clear reasons are found for so doing.

Sustained yield is a prominent and central idea in forestry literature. It came over from Germany 25 years ago in full strength and vigor, but contact with our own unstable business conditions has

moderated it. For immediate application it has, in fact, pretty nearly thinned down to the idea of the value of permanent industry.

That is surely a valuable idea, one that we ought to work toward. My intention in the present connection is simply to see that too much in this direction is not expected of the lumber industry and to point out advantages which have accrued to the public because of the industry's pursuit of the course it has taken. Nor should we neglect the real interests of the laboring men. This is for *prosperous* industry in the first place, industry that can pay wages because economically profitable. Mr. Goodman, for instance, meeting, as he must, current prices for forest products, may not be able to plan his operation so that it shall run at a profit continuously in a steady volume. If not, it is clear where the interest of his help lies. Perhaps the territory after a rest will again support a successful business. I have seen that work out at various points in my native country.

Of the advantages which the public reaps from the traditional course of the industry, the first is cheapness of production due to concentration and work on a large scale. A large industry affords competition and stimulus within itself and work is effective and cheap in consequence. Cleanness of work, also, as a rule reduces operating costs in the departments of transportation and construction. The result in lumber price the public appreciates and it will want to see clear reasons for so doing before surrendering it. Recently, for instance, I figured on the cost of logging operations in Douglas fir, and from a base price of $4 per thousand reached figures all the way up to $11.50 for conservative or salvaging work, according to the suppositions.

On the other hand, we have frequently seen demonstrated the riskiness of thinned timber, and for purposes of repair the force of natural reproduction and growth in what looked like unfavorable conditions. What these avail we are already experiencing. Florida, already referred to, is in point, and the biggest illustration I can think of is the South Atlantic pine belt. A large industry there located works on second growth, while it has been recently stated by foresters of standing that there is more timber now in the States from Virginia to Georgia, inclusive, than stood there at the time of the Civil War.

This last point, and indeed the whole trend of the paper, leads up to a consideration of growth, supplies and use, and that subject

can be started in line with the title of this paper by saying that I consider the lumbermen of the country have rendered it a great service by not being stampeded by the idea of a timber famine. Some of them, perhaps, were; at any rate some used the idea for their own purposes. But the wise, cool, trustworthy men, though they said little, did not believe it. The bigness of the proposition appealed to them—the difficulty of sizing it up statistically; then they realized, in fact felt in their own persons oftentimes, the vigor and resource of a free people that I mentioned earlier as a factor in the whole situation.

And see how that confidence has been justified. The big factor of the lumber market today, as Mr. Kellog has explained, is substitutes. With the levels of lumber price reached ten years ago, an opening was given them in many uses, and that movement has grown steadily in volume. The bearing on the sufficiency of our timber resources is evident.

Nor can I omit touching the other aspect of the matter—the statistics and predictions. Lumbermen kept silent about them for the most part because, as interested parties, and in the minds of some under indictment, they could say nothing to effect. But others did take occasion at the time to make objection. Here is correspondence to show that I disagreed not only with the predictions but with the figuring. Dr. Fernow said he believed the figures untrue, and not only that, but dangerous if used as an argument. Yet through all the years that have elapsed since, that three-to-one proposition has been taken as a starting point by nearly every man who has discussed broadly the forest problems of the country. That this ground should be retraversed and ideas circulated believed to be sound on the basis of present information and judgment seems to be particularly desirable at the present time. That in the circumstances would appear to be due to the lumber industry, while a further and particularly desirable result will be that in the time that is ahead, more effective cooperation should be had in the big common purposes from that body of men whose interests are most affected, and who by training are most familiar with a portion of the problem.

For I am not saying that there is no place for forestry in this country; I do not mean to imply either that we have more timber than we shall find a use for; nor do I greatly blame the men who in the critical times some years ago, to accomplish the big ends they were

fighting for, used any weapon they could lay their hands on. Quite the contrary, in fact, in regard to all of these matters. Of the essentials of forestry we shall certainly put in practice much more than we have as yet. I am saying that I think this will be done progressively, also that what we carry out for a long time to come will not be the forestry of the books altogether or even mainly, but that it will be free, new United States forestry, guided for the most part by economic conditions. That seems to me inevitable; if so, it is important that the fact be clearly recognized; as far as I myself am concerned, I think the work will be all the more attractive because not exactly what we first conceived it.

A few broad considerations may make the point clearer. Let us, in the first place, reflect where the forestry that chiefly fills the books came from. It came over from Germany, the most autocratic country in the modern civilized world. Further, it started about a hundred years ago when that country was commercially isolated and shut in, by a people at that time set on the idea of national self-sufficiency and regulated order. How different our own circumstances and aspirations at the present time! We are between two oceans. We are commercially ambitious and expanding. South of us are countries hospitable to industrial development, and among others vast forest resources of certain kinds are there. North of us on our western border is British Columbia with a great forest resource and a people pressing it to development. Across the Pacific, in northern Asia, are untouched forests of a reported vast extent. The world is small these days; its utilities are being searched out and through transportation put at the service of widely separated populations. We may regret this, think each country should be sufficient to itself, according to the German idea. I won't pass on that question, but I remember that twenty years ago this very year, when I first visited that country to see what I could learn from their forestry, I had the feeling that those Germans held too tight a rein over themselves for real men to thrive under; a lot of their practices seemed to me pedantic; and I will say this further in connection with events now transpiring that I think we might ourselves have blown up before this time if we had no more varied, original and interesting work to do than that of a German forest officer.

Application to various activities at home may further clear the matter. Take investigation to begin with. No understanding man fails to believe in the value of true scientific research that determines

fundamental elements. Considerations of timeliness and cost enter, however; then a people intellectually free like ours values empirical observation as well as research and will be likely to appreciate particularly reliable work under any name directed toward practical ends and reaching results that can be immediately utilized. Fortunately, I can illustrate what I mean by the study of yield in second growth pine prosecuted two years ago by Mr. Carter.

Cooperation is a big present field of activity, that thoroughly fits the training and ideas of our people, and I will only contribute the idea that it must be badly hampered by failure to get to the point of view that represents the real interest of the citizen. Not, however, that I mean financial interest altogether. I can, in fact, see how on a variety of grounds other than financial the interests of forestry are coming ahead in this country. Sentiment, family pride, and the general trend of public opinion are all operative in this connection, especially promoting the work of planting. Their aggregate effect will be considerable.

The term "regulation" has a different sound in the ears of an American. I think our people will go slow on this line, as slow as the necessities of the case permit, being especially suspicious of any who may manifest an evident desire to do the regulating. Let me, however, point to one or two things that show a progressive temper on the part of our people. In Oregon, the law since 1913 has required the private owner of timber to maintain a fire patrol deemed sufficient by the State authorities; in New England public supervision is being gained over belts of land along railroads and highways which, if uncared for, would constitute a fire menace. These provisions bear equally; they are broad, going to the source and establishing conditions essential to forest welfare; I think the temper of our people will support their extension. On the other side, a significant thing occurred in connection with the much advertised decision of the Maine Supreme Court, now some years old, when one of the judges, and an able one, too, refused to share in the decision rendered on the ground that the occasion was not of the momentous character specified in the State constitution.

The ownership of timber reserves and of land to produce a large share of the timber, we have believed a public function, and in this connection it is noteworthy that the present offers marked opportunities. That is for the reason that the interests of the lumber industry

at this juncture run in harmony with what we have looked on as the true and long-range interests of the public. The case on their side is ready. What shall be effected turns on the readiness of the public and the standing and competence of those who especially represent it.

I should myself, however, hate to see a movement in that direction go too far, for on large areas, in conditions which we have now or can expect, forestry of a certain type is harmonious with men's self-interest. The condition of things in the North Carolina pine country has already been referred to, and within a year papers by Mr. Ashe and Mr. Goodman have sought to interpret the facts and take best advantage of them. Somewhat similar things are true elsewhere. In fact, the application of forestry principles to business in land and timber promises, when men of genius have fairly made the connection, to be of great practical and general importance and a field of extreme interest as well. I could illustrate what I mean abundantly were there time. Believing that this will transpire and that it fits our people, I should myself hate, for instance, to see all the forest land of the Douglas fir region taken out of the field of private ownership and put under the blanket of the public sway. That is really out of the question, however.

In what has been presented I have been speaking, as I think, practically, of forestry as I look for it actually to come about in the United States. The picture in mind is of forestry, not a cult, or the possession of a group only, but a great enterprise of our people at large, entered on freely and with full understanding, in accordance with our genius and institutions, gaining gradually as occasion and necessity arise. In the end our forestry and our lumber industry will become one. And before that time can be said to have arrived, the interests of the lumber industry will very often run parallel with those of the future and the public in these matters. That community of interest should be understood and utilized as one of the most potent practical forces.

I realize that many reflections inconsistent with these ideas must have been in your minds during the reading of this paper. I will take up one that I am sure has been there, and then conclude with two broad views that I hope will be illuminating.

The enormous waste of timber that occurred in the pineries of the Lake States, and the lamentable present condition of much of the land concerned has been laid up against the lumber industry and indeed

against the country's intelligence. The facts are admitted, but against them I will set up two considerations. First, if the Lake States lost native resources at least they became populous and wealthy in other things, while a still more noteworthy fact is that the Prairie and Plains States were built up more quickly and cheaply than we can conceive of their being built under any other system. That is, with its faults our system also had its advantages, and the nature of both is such that the question involved is social and governmental, not technical.

For the second offsetting consideration I shall take you to another region where the course of repair that a great and wealthy country like this can make, and will make when the times comes, is already to be seen in operation. And here conservationists, as these were represented at an important period and in respect to some very material matters, will in my judgment have to yield in wisdom to the popular and business instinct.

Twenty-four years ago, when I first took up forestry, a critical point was the treatment of the White Mountain forests. In New England at that time economic conditions had just got around to call heavily on those mountain forests for lumber and paper stock. Loggers were inventing new schemes for getting that timber, and business concerns were in there stripping the spruce off clean as far as they could reach it. Nobody interfered in an effective way, but there was a lot of reviling of those lumbermen. They were robbers; they were spoiling the scenery; they ought to stop or else cut conservatively. However, people seemed glad to get the lumber and paper at lowest market prices.

The first relief came when the fact last mentioned was pointed out. Next a few men gained standing enough to convince people that if those lumbermen were going to cut those mountain slopes at all they ought to clear cut them; also that reproduction of tree growth was quick and abundant. Now for some years past we have been buying back these lands and putting them under protection and management. I will say for myself that I think in following this history these lands have served and fitted the life of this country better than they would under any other. From all except the scenic viewpoint, we are in ample time, for vast areas were not burnt or eroded, while all New England yet has large stocks of timber. A main point is that when the time came we had the wealth, created in part from the natural resources of that very ground, to do what was necessary.

I promised to give two broader views of relations which I hoped would be clearing. About a year ago I called on the representative of a London house in Seattle, there to buy lumber. On the wall of his office was a map of the world with the trade routes on it. The Douglas fir region was a spot on the map with him. Mexico was just as real, and South America, both with supplies of timber. And that great reservoir on the Armour River was in his mind also. Men of some nationality in the not distant future are going to open up that country, and set the product afloat in the world's markets. Now I ask, can you, in view of these facts, begrudge to our Douglas fir country realization on its resources while in some great foreign markets it has nearly a free field, and is it not a fair inference from this and other circumstances that the price of lumber in our own country will long be kept at such levels that intensive forestry will be financially possible only locally?

For the other view I take you to my home country. Years ago in Maine, as I first began to consider these matters, I thought in terms of the timber supplies of single water sheds. Here, for instance, was a paper mill on a river, and the question seemed to be how long the resources of that river would last that enterprise. But as I watched things, I found those men devising schemes I had not thought of. They began to use the railways for hauling timber. They hauled both ways across the State and by rail and water from three provinces in Canada, and the problem I saw was not a local but a regional one.

For twenty years past Maine has been realizing heavily on her timber. The trade has been profitable; the people have thrived on it, but a Simon-pure conservationist, perhaps, might have objected because, I suppose, the growth of the country, in some items and in some areas at least, was being more than harvested.

But what is happening today? A wealthy, ingenious, and ambitious people have cut a canal through the isthmus that connected the two Americas, and now lumber from the West Coast of the country is beginning to flow through there, and the prospect is that before very long it will displace Maine lumber in some markets, and Maine forests the people of Maine during the last twenty years had held themselves will have a chance to rest up and accumulate resources. Now, suppose down to a quantity calculated by somebody to be the volume of the State's production, what do you suppose they would think of themselves?

My purpose in this paper, whatever its effect may be, has not been destructive. I have, for one thing, for the economic forces in the field claimed general soundness and utility. Second, I have advocated opportunist, catch-as-catch-can forestry in the main as that which seems to fit our circumstances and people, and the kind that, frankly pursued, will yield most in the long run. I have also and especially spoken for recognition and cultivation of the country's lumbermen in the forestry movement—this in the first place because in the future as in the past the interests of these men will oftentimes run parallel with those of the people at large, a fact which should be understood and utilized; in the second because as that element among our people most familiar with the problems to be met, as the men whose interests are nearest and oftenest touched, and as containing among them a due proportion of high-minded and trustworthy citizens, their support and cooperation should be very serviceable for working out the problems of the future. Let me in conclusion mention a few things lumbermen have done that are, in fact, indicative of a cooperative attitude and fruitful thinking.

In May, 1907, the National Lumber Manufacturers' Association resolved in favor of a census of the timber resources of the country.

In 1910 Mr. James D. Lacy, at a meeting of the same association, suggested a world congress to consider the disposition of the world's resources in timber.

Lumber journals for the most part have strongly supported the National Forest system. Mr. Leonard Bronson, editor of the American Lumberman, told me some months before he died how, at the critical time, with his owners absent, he risked his job by committing that paper to the support of the system.

Last year, Mr. E. H. Cox, of California, came out with strong endorsement of the idea of extension of the National Forests through exchange of timber for cut-over land.

Tonight we have on our program a thoughtful and suggestive paper by Mr. Goodman of Wisconsin, sweeping over the whole field indicated by its title, "How to Make Our Forests Inexhaustible."

Further than that, I say with entire confidence that while many will be indifferent and some will watch merely to profit for themselves, still hundreds of right-minded, clear-thinking, trustworthy men connected with the industry will be ready with their influence, and their judgment too, to cooperate with measures that appeal to them as sound, timely, and well-planned.

LAISSEZ FAIRE VS. FORESIGHT IN FOREST MANAGEMENT[1]

By Burt P. Kirkland

Professor of Forestry, University of Washington

The services rendered to the cause of forestry by Mr. Cary and his well-known sincerity make one regret to disagree with him at any point. However, the writer believes that Cary goes too far in support of the *laissez faire* policy in industry—to a length, in fact, which recent national and international events have definitely demonstrated to be inexpedient to say the least. Moreover, Americans are already too prone to take the fatalistic attitude found in parts of Cary's article—that everything will come out all right anyway: "we should worry." Little attention will be paid to the attempt—disavowed near the end of the article—to read the trained forester out of the lumber industry and in fact out of any useful position in our national life. If the trained forester had no place in the lumber industry he would never have become so firmly established as he is. The introduction of the trained forester into the business depends on his being able to give service in it.

Many forest schools have for several years proceeded on the theory that the lumber industry is included within the scope of forestry. With that idea in mind attention has been given to instruction in logging engineering, forest products, and the lumber business in general, and it is held that forest finance includes the finance of exploitation forests and their organization, the organization of exploitation forests. The schools do not find these combinations inharmonious, but quite the contrary. In forest finance, for example, while it is true that the handling of forest lands for continuous production introduces different elements into the problem from those encountered in the exploitation forest, nevertheless the former throws extremely valuable light on the latter. Indeed, if principles applicable to finance of production forests had been known and followed by more investors in forest lands, many of them would have been far better off today.

Looking at the question from the standpoint of the lumber business, it is proper to inquire whether the inclusion in the lumberman's

[1] A Reply to Austin Cary's paper: How Lumbermen in Following Their Own Interests Have Served the Public.

training of some knowledge of forest production should be useful. Frank Vanderlip, of the National City Bank, and many other equally successful business men are now sponsors for the idea that the business man needs a broad training, including all branches of business—not merely the one in which he is engaged. If this is true, then the proposition that the silviculturist needs to know something of utilization (the lumber business) and that the lumberman needs to know something of forest production can certainly be easily substantiated. As Cary has recognized, the lumber industry is now entering into world competition; the big broad-gauge lumberman will, therefore, want and need to know what he has to compete with in the way of timber produced under the hand of man both in this country and abroad. For example, should there arise in the lumber industry far-seeing organizations like the United States Steel Corporation, which assures its supplies of raw material 50 to 100 years ahead, would it not be extremely useful to the manager of such a concern to know that supplies of timber to be used 50 years hence can be grown at a fraction of the expense they can be provided by storing up stumpage acquired now at $2 or more per M feet?

Cary's article is in a large measure a challenge to the whole system of training for forest industry. Since the modern verdict is overwhelmingly in favor of such training in other lines of endeavor, from agriculture to law and medicine and even business itself, not much space need be taken to discuss this question. The writer will content himself with pointing out that men in their industrial activities may be classified into three classes: first, those who can profit neither by their own first hand experience nor by the experience of others; second, those who can profit by their own experience but not that of others; and third, those who can profit both by their own and by the experience of others. Not every man who takes the forester's training can qualify for this last and highest class of ability, but it must be the function of the trained forester to bring world experience to bear on the problems of both forest production and forest utilization in America. It is the business of the forester to foresee as far as possible the future evolution of forest industry in this country and help prepare the industry for the changes that are coming. The forester should be in a position to do this because he knows world experience, especially that of nations that have already passed through industrial stages we have not entered. No American forester that I know of ever advocated grafting

the forest system of any other country on America. This does not mean that we here can or should violate the natural and economic laws on which forestry is based simply because most of them were first worked out in Europe. To my knowledge neither foresters inside or outside the Government service have tried to apply more than the natural laws, not to imitate the systems or methods in detail. In the three forest schools with which the writer has come in contact it has been taught very specifically that the European methods, even in planting and nursery practice, are for the most part quite inapplicable here. Nevertheless, it cannot be doubted that, like Japan, we should go to all the world and bring home all that is applicable here instead of adhering to the narrow prejudice which demands that we profit only by our own first hand experience. One of the chief dangers we face as a nation is doing just this—failing to profit by the experience of other countries.

As to the main thesis of whether the lumbermen in serving their own interest have served and are serving the public, in the first place it may be said that our industrial situation would be hopeless indeed if the interests of any big basic industry like the lumber industry were radically at cross purposes with public interests. The industry embraces too large a section of the public and is too intimately connected with other industries for this to be true. Most of the public is interested in some industry and all industries suffer together when one big one is unprosperous. Also it is obvious enough that since the remainder of the public pays the lumber industry for the services it gives, naturally enough the industry will get pretty close to the public desires and thereby earn the highest possible reward. It may be said further that, so far as the writer knows, foresters have never blamed lumbermen for methods of the past, though it is not difficult to show that on purely economic grounds in some regions far different methods would have served both the lumberman and the public better. Foresters have always endeavored to secure the cooperation of lumbermen. That was the chief line of activity of the Bureau of Forestry in the years before 1905, nor has that line of activity been dropped since. Now that their twenty years of effort are beginning to bear fruit it is gratifying, especially to those who early followed this policy, that at least this policy of the profession has approval by a man of Cary's experience in the industry. In my opinion the public should accept its full share of the blame for any waste of forest resources which may have taken place.

So many points are touched upon throughout Cary's discussion that no effort will be made to take up each in detail. As a basis for further argument it will first be noted that Cary shows much evidence of having fallen into the current fallacy, now quite common, of believing that because there is more timber in private hands than can be realized upon quickly at a profit, or in some cases at cost to the investor, that there must therefore be an excessive national supply. It is true enough that there is very much more mature timber than would be needed if we had provided in the past young stands to come to maturity and furnish our annual cut after the present mature timber is cut. Even as we stand, most foresters lay emphasis on measures to assist in marketing our mature timber at a profit today and at the same time on providing for tomorrow's supply by keeping our forest lands producing. With this latter point in view let us examine for a moment this question from the standpoint of national supply. In so doing it will be assumed that we shall use as much timber annually in the future as we do now if we can get it at reasonable price. This is to assume that our standards of living are to be maintained in the future (which it is hoped is a safe assumption) and that the inroads of substitutes will not more than offset our increase in population. The question of the substitutes will be briefly dealt with later. Every one knows that in order to produce saw timber there must always be on hand in the woods a large stock of standing timber. The question here is how much must be our national stock in order to maintain our present annual production. In order to ascertain this there seems no reason why we should not apply the formula—Annual growing stock= $\frac{\text{rotation} \times \text{annual increment}}{2}$. To maintain our present cut, annual increment must equal this cut in the long run. It seems clear that taking all our forests, including such areas as the Rocky Mountain, New England, and the South, into consideration, that 80 years would be the minimum average rotation that could be assured. If so, a normal growing stock upon which to base a continuous yield (equal to our present cut) must be forty times this annual cut plus woods and mill waste plus annual fire loss plus loss from insects and fungi plus windfall and other miscellaneous drains. Space does not permit detailed analysis of the most recent figures showing the total drain on our forests and, moreover, the writer does not wish to sow here the seeds of an additional controversy over details. He will, therefore, rely on the old rough figure of 100 billion feet b. m. annual consumption,

adding the statement, however, that detailed consideration which he has given makes a more favorable showing for his argument on this older figure. $\frac{80 \times 100 \text{ billion feet}}{2} = 4{,}000$ *billion feet, the normal growing stock necessary to continue our present cut, according to the above method of calculation.* It is not overlooked that the Department of Commerce and Labor estimates of 2,800 billion feet do not include the portion of the standing timber unfit for saw-timber, but it must be remembered that this will mostly go for woods and mill waste. Since, however, the latter have been excluded from consideration in the annual drain, they should be also excluded from the estimates of the stand. It is further conceded that there is a large volume of young growth, especially in the farm woodlots, which helps to make up part of our necessary growing stock, but this added to the best estimates of our commercial stands cannot pile up a total greatly in excess of our permanent needs for growing stock volume if our forest resources are to be handled on the basis of a going concern, instead of taking from them only the wrecking value. On the basis of saw timber estimates the writer concedes that we have a 50 to 70 year supply at the present rate of cutting, so the "we should worry" attitude may be entirely justified for those individuals whose patriotism is of that order which cares for the conservation of national resources only during their life time. The fact is, however, that neglect of these resources will lead to scarcity, and therefore high price, which will affect many of the individuals sooner than they expect. It should be reiterated here that these arguments are not addressed to those who feel concerned only over their individual fortunes, but to those who wish to see preserved the material basis for continued national existence, because without the material basis there will be no opportunity for working out our national genius to its full fruition. In my judgment, the American people are turning quite definitely from the *laissez faire* system of handling industry to control in the interest of the whole community. Let me quote on this subject Theodore N. Vail, a man who may be an idealist, perhaps, but not so one will suggest that he is an impractical one. His words are: "There is too much indifference to, and toleration of, the selfishness of individuals, which allows them by encroachments, small and large, upon common rights to make impossible the enjoyment of other individuals, or by the public as a whole, of their rights. It is time we stopped talking about the independence

of the individual which, in effect, is only surely self-indulgence and egotistical self-assertions and a bad excuse for bad education and bad breeding."[2] Besides our increasingly successful efforts at the control of transportation and other public service corporations we are soon to see the establishment of a zone system in cities whereby industrial, residential, and business areas will be established. Further indication of this same trend is the experience of the present national administration which expected to realize the "New Freedom" by reducing the tariff to restore free competition and by then taking the hands of the Government off of business. It has found it necessary to initiate its reforms, however, by the Government taking more hand than ever, as instanced by the formation of additional commissions to supervise business. Likewise though the apparent drift of the forestry profession for nearly ten years has been toward the *laissez faire* school of forest management the writer expects to see this school definitely discredited in another ten years. Indeed the practice of forestry is inherently opposed to hit-and-miss methods. Only superficial knowledge of forest production is necessary to convince anyone that only orderly action based on clear scientific foresight—the "supernal commonsense" of Harrington Emerson—will secure anything like the full productive possibilities of the forest. Furthermore an increasingly large and intelligent portion of the American public is coming to the position set forth by Mr. Vail—that the apparent freedom obtained by absence of any control means only freedom for the strong to overrun the rights of the weak. It may be true that we can continue on a saw-timber basis for 50 or 70 years and when our timber is gone draw on Siberia and the tropics, as Cary wants us to do. Possibly we can get along fairly well with the tropical woods as substitutes for our own, but the writer's contention is that it will be no more intelligent for us to leave our timber producing plant (forest lands unsuited to agriculture) be idle and send abroad for timber than it would be for the manufacturer of boots and shoes to close down his plant and pursue the same policy. The first is as good and no better as a national economic policy as the other is as a private business policy. Besides, international trade can be carried on permanently only by the interchange of commodities. If we are to import timber we must export the product of some other resource, iron manufactures, for example.

[2] Theodore N. Vail. Address to Vermont Forestry Association. American Forestry, September, 1916, p. 549.

It seems very clear indeed that of all products which might be produced and sent into foreign trade, forest products, consisting as they do mainly of air and water acted upon by solar energy, are among the most advantageous. It is well known, in fact, that proper management of forests improves the soil, hence the intelligent production and export of forest products will remuneratively employ our labor. At the same time it continually puts our resources in better producing condition. What is the case with our copper, iron and other metals? The more we sell the poorer we become in resources. I do not wish to see the production or export of the latter restricted, but I do believe that if any industry deserves encouragemnt by the nation it is forest production, and that if private interests are unable to maintain their portion of our forest resources in producing condition adequate remedies should be taken. Not that any hostile attitude toward the private interests is in any way called for or that they should be put to any burdensome expense; the writer's belief is radically the contrary.

The matter of substitutes is one which might be discussed at length, but only a few points can be touched upon. Modern engineering and business specialists have become aware that there is practically no such thing as permanence in use value of any structure. Even if the materials are permanent all structures become in time obsolete. This obsolescence is particularly active in the case of buildings. In all probability, every business structure has outlived its usefulness after 15 or 20 years of service, no matter what the materials. Improvements in lighting, plumbing, heating, and in the case of manufacturing buildings, changes in machinery, have rendered the structure obsolete, and if use is continued the business is placed at a disadvantage. Why, then, put permanent material into impermanent structures? The fact is that when the time comes for wrecking these structures the permanent materials are a curse, as in the case of concrete and steel. Only valuable city property will, as a rule, bear the cost of salvaging from these incumbrances. Eastern farms are covered with the scars of old buildings though only foundation walls remain. If the land is not always worth salvaging, it certainly will never bear the enormous expense of removing an obsolete concrete structure. Wood is still cheaper than these substitutes, plenty permanent enough and can be largely salvaged when the structure it forms a part of becomes obsolete. When these and related facts become known, as they will through lumber advertisements, the false idea of permanence in structures will be punctured

and wood hold its own, if not regain lost ground. In the matter of fire resistance, Mr. R. S. Kellogg is authority for the statement that insurance rates are lower on mill constructed buildings protected by automatic sprinklers. The business sections of cities will more and more be constructed of fire resistant materials, but an enormous field remains where wood is still the most economic material. It is probable not one per cent of the farms in the United States are fully equipped with buildings.

A recent article in the Country Gentleman[3] shows that silo construction is not even keeping pace in number with the increase in the number of farms in the United States. The same article states that "many farmers who are holding off on the silo question, waiting until the day when they can build a more permanent type, might earn the money by installing a wooden one." The only objection to this statement is that in the majority of cases the properly constructed wooden silo is as permanent as the more expensive types, because even the silos of permanent materials will become obsolete, usually through location. Another article in the same number of the Country Gentleman shows the possibilities of salvage of lumber from wooden sheds.[4] Wherever the land is suited to permanent agriculture, progress of methods in all lines and increase of production by more intensive methods will necessitate rearrangement and enlargement of the buildings from time to time. The writer has had personal experience on farms both in the east and west and is familiar with conditions in several widely separated localities. On the basis of this first hand knowledge he does not hesitate to affirm emphatically that over 90 per cent of the present farm structures, both residential and for farm operations, are obsolete according to the best present standards. On the same basis of experience and observation it is a safe estimate that the average farm in the United States could use economically 50,000 feet of lumber in construction at once. That would mean 300 billions of feet. We have the timber, we have the labor to handle it, and the obstacles to the proper rural credit and other economic rearrangements are not insuperable to placing this timber on the farms, where it belongs, within a reasonable length of time. This would be only a beginning in farm use of lumber, since maintenance, replacement, and enlargements of farm structures due to the certain increase in farm business which must

[3] Country Gentleman, September 30, 1916, p. 1759.
[4] Country Gentleman, September 30, 1916, p. 1746.

come to maintain an increasing population will require increasing amounts. Much could be said on improvement of methods of distribution within the lumber industry itself as one aid to bring this condition about, but space does not permit.

A few further examples of what is meant by obsolesence may be given. There recently came to the attention of the writer the case of a small manufacturing concern in a Kansas town. A few years ago this concern built a "permanent" concrete and steel factory building. Recently the business has increased and more space was needed. It was found impracticable to enlarge the building at reasonable expense, however, on account of the concrete and steel wall construction. The concern could not afford to build another complete unit, so the business remains permanently cramped. A wooden structure in this case could have been easily enlarged and, moreover, if the money that could have been saved in the original cost of construction by building of wood had been put in the bank it would have built the addition.

Take another case; suppose the Milwaukee railroad in making its west coast extension, completed less than 10 years ago, had elected to have "permanent" construction throughout and had built concrete coal chutes. Now that this extension is being electrified the loss on these would obviously be large, considering the unnecessary high original cost and the present heavy cost of removing these structures rendered obsolete by the change in power.

Consider another railroad case; for instance the comparative advantage of creosoted wood bridges, and concrete and reinforced concrete structures. The former can be built at half the cost and in case of replacement of the bridge nearly all salvaged. In the latter case the salvage is nothing, but the cost of wrecking and removal, tremendous. Yet, railroad bridges may become obsolete at any time through increase in the weight of locomotives and other rolling stock. This has already happened several times in American railroading and let us hope progress has not yet ceased.

Then again, looking at another point of view, suppose concrete construction does increase. Some systems of concrete building construction require more wood than would be the case if the wood were to be the permanent material. This is true because the concrete before setting constitutes a greater load than the permanent loads of the building contents. I feel justified in enlarging upon the above and similar considerations, indicating that wood will be useful and largely

used in the future as in the past, because of Cary's frequent implication that we shall not in future be in such need of wood as in the past and therefore our forest resources can be allowed to be idle. The faith of the lumberman and the foresters in their product will yet result in increasing wood consumption. This is desirable, because here is a resource which can by use be continually improved and its product increased. It can be said of the waterfall that its use can be accomplished without diminishing waterpower resources, and a similar statement is true of few resources. The position of the forest, is, however, superior to this for its use coupled with proper care not only will constantly improve the composition of the stand and increase the output, but the soil itself can be constantly increased in productiveness without the aid of artificial fertilizers.

It may be pointed out further that stumpage prices on the better species (the ones that will be raised under management) are already amply sufficient to justify production under management all over the northern States from the Mississippi valley eastward even if artificial regeneration had to be resorted to. They are already equal, as Roth has shown, to stumpage prices in Germany. Yet lumber at prices sufficient to allow these stumpage rates still enters freely into building construction. *The fact is that modern industrial methods can raise forests under management, log and saw the timber at far less expenditure of human energy than the latter two functions could be performed a century ago.* The conclusion is that since the same improvements have taken place in other industries we shall be able to continue to use wood at a high per capita rate even though it must be produced under management. Continual improvement in methods of production and distribution and our economic arrangements in general can unquestionably (if we have the intelligence Cary credits us with) result in raising the per capita consumption of timber in this country to an amount equal to the full capabilities of our forest lands to produce it, a point which we have not yet reached. How many of us are provided with as good houses, even of wood, as we would like? Yet at many times we have large numbers of men unemployed, though wanting work, and all times still larger numbers employed at such low wages as to possess a very limited purchasing power for houses or anything else. Until these conditions are changed we cannot realize our full per capita consumption of lumber or anything else. I share Cary's admiration for the intelligence of the

American people to such an extent that I am fully convinced that we shall work out improved methods of production and distribution of lumber and other products, so that the lumberman, for example, can convert more trees into lumber and sell it to the farmer, who in turn will be able to pay for it through the sale of more of his farm products. The forester is already equipped to help in the solution of this problem and is better equipped every day.

To revert again to the question of importation of supplies and at the same time to domestic transport to a distance, it is an easily demonstrated fact that transport of wood to a distance is more expensive than to raise it locally, where the conditions are adapted to economic forest production. This was indeed the main reason for the rise in lumber prices in certain sections. In my own native country, western New York, lumber jumped in a short time, about 1900 to 1905, $10 to $20 per M feet. The occasion for this rise was the near exhaustion of local supplies, which necessitated import from the Lake States and the South, and hence the imposition of transportation cost and middlemen's costs and profits. The report of the Forest Commissioner of Maine for 1912 shows that most of the timber used in its industries was grown locally and the cost to the users moderate.[5] The report of the State Forester of Massachusetts for 1913 states that forest production is profitable at less than the transportation costs of Pacific Coast timber, which he states is $20 or more per M. feet.[6] This will probably be cut in half by regular service through the Panama canal to coast points, but for inland points damage in sea transit, yardage costs at coast terminals, middlemen's costs and profits will prevent much reduction of this figure, which is higher than the average value of spruce stumpage raised at good profits in Germany.[7] The fact is that in most localities in New England far the cheapest way to supply timber to local industries is to raise it locally and sell the logs or rough manufactured product direct to the local user. This cuts out a vast accumulation of freight charges, insurance, middlemen's charges, etc., largely representing unnecessary human labor.

Cary dwells at considerable length on the social value of having

---

[5] Report of Forest Commissioner of Maine, 1912, p. 151. Wood-using industries reported by J. C. Ellis.

[6] F. W. Rane, State Forester. Tenth Annual Report, 1913, pp. 8 and 9.

[7] Roth, F. Forest Valuation, Ann Arbor, 1915, p. 92.

"*need supplied with the least sufficient effort.*"[8] It is to be feared he has chosen an unfortunate illustration. The rule of primitive man to go and take what he needs at the least sufficient effort is what has very nearly destroyed our game, our fish, and many other resources susceptible of this treatment. The people of more advanced civilizations know that in many cases need can be supplied with less effort by temporary abstinence. Moreover, this temporary abstinence, in many cases, brings immediate reward because the future values to be produced may be immediately discounted and given a present value. The builders of railroads may reap a richer reward than they would by supplying their "need with least sufficient effort" in a period of high living. Other capitalists are willing to reward their efforts and expenditures at once, because the future returns from the railroad may be discounted to present value. The forest constitutes a similar case. Production of timber by this generation, though it may not be used until the next, can meet with present reward if the enterprise is properly organized because the future values can be discounted and cashed in at the capitalized value. At the same time it maintains the beauty of the landscape, gives value to land otherwise of little value, and employs some local labor in growing the timber, although most of the growth comes as a result of using resources otherwise unused through giving nature only a little guidance. Much local labor will be employed in the utilization and a chance given for the preservation of the New England lumberman, whose spirit need not be unduly depressed by the knowledge that the timber he is cutting was protected from fire, or in some cases even planted, by man.

Incidentally, New England forms one of the best examples of how greater foresight would have paid both the lumbermen and the public in New England. The fact that stumpage of local timber is now, or soon will be, based on transportation costs for outside timber, such as shown above, means that forestry would have been profitable in New England *for at least 50 years past* even if the timber has been planted, which was seldom the case, since in most cases only improvement, care and protection of naturally reproduced forests was involved. Forestry, it may be repeated, would have been profitable because the product produced would now sell at prices to pay interest on all costs of production. Few will deny that this cheaper local supply of timber, so created, would be a great boon to local land

[8] See p. 279, Cary's article.

owners, laborers, and wood users in New England today. *The writer will, in fact, go so far as to affirm that from the standpoint of the forest investment the past period was a more profitable period for the practice of forestry than the future can be.* Why? Because demand and prices for wood have all this time been sufficient in the average locality to give a current return on the investment in forest land and timber which, being acquired at low prices, would have afforded a satisfactory interest yield on the necessary investment. In addition to the current return there has been an enormous *appreciation* in timber, if not in land values, which would have made an additional return on the investment. This appreciation in timber formed, without a doubt, a considerable percentage on the land and timber values which it cannot do hereafter, because the values are now so high that an increase of 25 cents on stumpage value, which in the old days would be several per cent on the investment, will in the future be no more than a fraction of 1 per cent, not of material aid in increasing the *total per cent earned by the forest investment.* Therefore, the writer concludes that New England would have been far better off if a small portion of the capital it sends away (say a portion of the capital invested in "Boston" mining stocks) had been expended at home. Starting with the forest, as it could have done, the amount of capital required would really have been negligible With this policy more of its sons would have been retained at home and the traditional New England culture better perpetuated than has been the case everywhere. The writer believes that these regional types of American culture, of which New England and the South are examples, constitute an enrichment of the national life not incompatible with national well-being. But to preserve the racial stock and the type of culture the environment must not be allowed to change too violently. Thus, the old lumberman stock, deprived of its native habitat, "the forest" has of necessity largely perished, as Cary recognizes. It has become a rare species as many of the species comprising the fauna and flora of the forest, when the fire-scarred waste succeeds the forest canopy.

The writer cannot claim Cary's familiarity with New England, but does not hesitate to affirm that more attention to the New England forest in the past would have involved maintaining a larger proportion of the population in forest industry today. Sharing as he does Cary's admiration for the old-time lumberjack, he believes that the woods-

worker type would form a desirable leavening to the population of the factory towns. It would also have maintained greater freedom of opportunity and meant life to the soul of many a worker whose spirit is crushed by the industry of the cities, but who can choose no other because the opportunity is limited. This limitation of opportunity is indeed dangerous to society and a far healthier community life is possible where a reasonable balance is maintained between the open-air occupation of the country and those of the town, because under these conditions a constant interchange can take place between the population of the country and the town. Moreover, in the more remote districts the maintenance of forest industry would also have maintained agriculture on the better lands, as the presence of forest industry in the Pacific Northwest makes profitable agriculture possible on lands which could be cleared with difficulty to compete in distant markets.

Thus it appears that least of all American communities can New England afford to see her forest lands be idle for a period of recuperation, while her population is confined to the towns, and the Pacific Northwest supplies her lumber.

Fortunately for New England, many of her stands are of such type that temporary self-interest did not permit clean cutting, therefore, forestry has been practiced to a large degree, although until recent years inconspicuously. To these facts and not to temporary self-interest New England owes the forest wealth she still possesses, and on the basis of which she is in a position to restore her forest wealth at less cost than can be the case in the complete ruin of much of the Lake States pineries.

The picture of the sawmill settlement is as attractive to the forester as to the lumberman, perhaps more so, for the former wants to see that picture perpetuated forever, while too often the latter is content to see it vanish with timber handled on the timber mine basis.[9] The forester does not wish to see deserts and abandoned shacks and waste of sawmill debris succeed this prosperous community. The forester has his own idealism and would add other beauties to the picture. He would see permanent homes, lawns, flowers, succeed the temporary shacks of the average sawmill or logging camp. Even the wood substitute in its proper place—the

[9] For effects of permanent timber supply in the sawmill see Forestry Quarterly, Vol. XIII, No. 4, p. 493, Article on European sawmills by J. B. Berry.

cement sidewalk—might be admitted to the picture. He believes that the family life will unfold more serenely in these environments and that the contribution of the permanent forest community to the "Spiritual Capital" of the nation will be as useful and more lasting than the temporary one. At any rate the temporary one has doubtless made its full contribution and it is time for the permanent one to come on the stage. The writer is convinced that from the human standpoint the nation sorely needs permanent forest production. It needs the ethical influence of forestry properly conducted with care for perpetuation of these resources to offset the influence of those industries which can exist only by destruction of the resource that maintains them. The thinking man who engages in the oil industry knows that his efforts are day by day helping to bring that industry to its close, sooner or later. Such an industry might well be conducted on a more selfish basis than forestry or farming, where the practical idealist can find full scope through the knowledge that his own ends can be served at the same time he is helping to create a better heritage to leave to the future of his nation. In fact, in the long run national existence itself depends on the maintenance of the renewable resources. Moreover, it must be remembered that as one resource after another is exhausted the burden which the renewable resources must bear will increase. It may not be possible to show that America has yet felt the burden of exhaustion, but we are distinctly beginning to feel the "saturation point," as it may be termed, meaning thereby the point where it is no longer possible for the average man to put his hand easily on some resource that will yield large returns. It is a well-known fact that in parts of this country labor has begun to feel all the pinch of narrowed opportunity that the labor of older countries feels.

There are few higher patriotic duties, then, than the maintenance in producing condition of our renewable resources. Certainly our forest resources are only second in importance to our agricultural soils in this country. It will assist in no small degree in rendering opportunity to our increasing population. Most of the desirable results mentioned above are unattainable except through an appropriate annual sustained yield, an idea not so "thin" as Cary would have us believe and not at all impracticable in vast numbers of forest tracts. It is in most cases impracticable only where forestry is impracticable. This idea will not be further exploited here. For complete

treatment of the subject see Roth.[10] The writer has also given partial treatment in a preceding article.[11]

However, with all his idealism, the true forester strives always to keep his knowledge workable. It is desirable, then, to point out here that such care of an existing forest as will make it as valuable 50 years hence as today (a thing which can be done, though returns are taken annually from the forest) gives in a real financial sense its reward today. Why? Because all future values may be discounted to present value. If the United States Government should issue this year 3 per cent bonds running for 50 years they would unquestionably sell at par at once. This would happen not only because 3 per cent interest is to be returned this year and next and the year after, or, for that matter, for 50 years, but also because the principal is to be paid at the end of 50 years. Equally, forest values, which are assured to any forest owner 50 years hence, have their real value to him today, though not so easily recognized as in the case of the bond issue, partly because they are not so easily determinable. There is, however, plenty of reliable American data to show absolutely that these forest values will in many regions give a real return above the expense. Moreover, as Professor Roth has shown,[12] there are few businesses in which the future results can be predicted as accurately as in forestry. No matter what the future values may be, however, the writer does not believe that forestry beginning on a bare tract is practicable in any large and effective way for either private owner, State, or nation. The expenses are too great and the wait for returns too long. Should the State of Washington spend $100,000 per annum (an extravagant sum in a State which, for protecting its existing forests, spends annually $37,500) in planting up deforested areas, it could even at the start plant up no more than 10,000 acres annually. This annual planted area would have to be diminished continually in order to leave available sufficient sums to protect and administer areas already planted. In less than 50 years the entire sum would be needed for administration, because little or no return from this planting would be available before that time. But ignoring this necessary

[10] Roth F. Forest Regulation, Ann Arbor, 1914, and Forest Valuation, Ann Arbor, 1916, especially p. 82 and following.

[11] Kirkland, Burt P. Need of Working Plans on National Forests and the Policies Which Should be Embodied in Them. Proceedings Soc. American Foresters, Vol. X, No. 4.

[12] Roth, F. Forest Valuation, Ann Arbor, 1916, p. 22 and following.

deduction from the area planted the entire 50 years would plant only 500,000 acres. Yet, in the State of Washington some 250,000 acres[13] is logged off annually—one-half as much as would be reforested in 50 years at the above rate. Yet, the writer doubts the ability of the profession or all the propagandists it can enlist to hold the State legislature to 50 years of such expenditure bringing, as it will, no return during this long period. The greatest achievements of reforestration in Europe, such as the reforestration of the Landes in France, involved less than 2,000,000 acres and took over 40 years, with State, commune and private ownership cooperating, according to Fernow,[14] but this being turpentine forest yielded returns much earlier than most American forests will, and forestration was carried on in an old and densely populated country. Important as they were, they are a mere drop in the bucket compared with the reforestration problems of a single American State, where clear cutting is the necessary method, as in Washington, where in seven years we cut off as much as France reforested on the Landes in 40 years. The conclusion seems sufficiently clear that if this resource is to be perpetuated, *we must start while we have the forest.* Wait till the forest is gone and restoration will be the work of centuries during which this resource will support a small fraction of the population it could well do, and other industries must feel an unnecessary pinch for forest products and pay a wholly unnecessary price for what they do get. With these to his mind incontrovertible facts, the writer is content to let the defense rest in the case of *Laissez faire vs.* Foresight in American Forest Management.

[13] Bull. No. 239, U. S. Dept. of Agriculture, Cost and Methods of Clearing Land in Western Washington, p. 8.

[14] Fernow. History of Forestry, 2d edition, Toronto, Canada, 1911, p. 227.

COMMENTS ON KIRKLAND'S CRITICISM

By Austin Cary

Logging Engineer, Forest Service

Professor Kirkland, in his comment on my paper, as always when he writes, has struck off some very attractive ideas. One is unavoidably stimulated, and generally sympathizes even when he cannot agree.

The first counter consideration urged, one that Kirkland also can take shelter under, is that in developing a big subject with wide bearings one is obliged to make good his main and characteristic points by emphasis and concentration. This in the interest of brevity has to be done oftentimes at the expense of balance in regard to what are for the time being side issues. Thus in regard to the place of forest schools and technically trained foresters in the present movement. The writer did not express views on this point, and does not admit inferences drawn by others.

Nor am I fairly open to the imputation of thinking that because timber ownership today is a financial burden in some forest regions the country is shown by that fact to have more timber than it will require. This opinion is expressly disclaimed late in my paper. It is the system of timber ownership that is at fault here, not Nature.

Like Kirkland, I do not wish to thresh over old straw or start controversy about details, but I do feel that his computation of growing stock necessary to produce our present annual cut of forest products should be questioned as somewhat similar presentations have been questioned before. Only suggestions will be made here, and those as far as the basic data are concerned, are from memory.

1. Of the 100 billion of annual products of the forest, about 40 are saw lumber; the balance minor products, of which firewood constitutes a large portion.

2. Available estimates of timber stand are of saw timber only.

3. In this connection the questions arise: (*a*) How much of the 60 billion feet of minor products comes out of the saw timber as a by-product? (*b*) How much of the same 60 billions is obtained from stands that never were figured in the estimated resource? (*c*) What are the volume, availability, and producing capacity of those unestimated resources?

The writer does not remember to have seen those questions answered and supposes it impossible to answer them, but he believes that were due weight given to the points named strong modification would be made of Kirkland's figures. In particular the East is believed to have great areas of forest land whose resources have not been reckoned, but which produce or will produce great quantities of forest products on a short rotation.

Right in that connection Professor Kirkland suggests a point not developed in my article, but which lines up remarkably well with its main theme. Just before presenting the formula for growing stock, he states that had we in the past provided young stands to come to maturity later on, we should now have more mature timber than would be needed. In that connection, I ask if the fires that for several decades we allowed to rage in the western forest regions did not do that very thing, on a large scale, if imperfectly and without discrimination. Does not the whole West show it? Is'nt the country better off today for much of this replacement? What more do we need to make the greater part of that area serve exactly the purpose he has in mind than simple protection?

As one inclined toward *laissez faire* up to the point where really substantial interests of the country can be shown to suffer by its perpetuation, as a believer (like Kirkland) in the general soundness of industrial forces, and further that these can be supplemented by educational means, I wish to take up one of the regional situations that he presents to suggest my own line of treatment. His picture of the Northeastern States as industrially ripe for forestry is a striking one. Terms would have to be defined before I would myself assent, and he seems to qualify the idea by the statement that forestry is too hard if there is only the bare land to start with; but letting that go and taking what he says for granted, I have a suggestion as to how things may best be set and kept in motion. As I see it, that will be done in the main if men who understand the situation go to work themselves, with their own money and ability, to utilize it for their own advantage. I can assure him on the basis of experience that nothing will so start up popular appreciation of growing woodlands, so focus people's attention on them, incidentally securing their protection, as to have a few tracts bought for investment. I can't myself think of any other force that could operate so powerfully.

Professor Kirkland's vision of permanent forest industry is an attractive one. He is himself our most concentrated student of economic conditions bearing on its practicability. About midway in his comment is a very forcible sentence on another line—"only orderly action based on clear scientific foresight will secure anything like the full productive possibilities of the forest." No one desires to counter that of course, and still by fair consideration, along the lines of my own paper for instance, its impact might perhaps be mitigated. As a matter of fact Kirkland himself at another point suggests a limitation when he says that "the true forester strives always to keep his knowledge *workable*." The last word there is the important one, the one over which is likely to arise difference of opinion. The man who is close to a given thing may have a different view than the one farther away, the man really responsible from the one who stands free, the man who deals mostly with principles from he who habitually deals with men, while age and temperament will be at the root of further differences of opinion. We want always to remember in our discussions that in these matters relations and interests are at least as varied as the viewpoints to understand that even the patriotic feeling which Kirkland invokes may not bear all in one direction.

TIMBER ESTIMATING IN THE SOUTHERN APPALACHIANS

By R. C. Hall

Forest Examiner, Forest Service

The systematic estimating of timber in the southern Appalachians presents some problems which are common to that branch of forestry in all mountainous regions, and others which are perhaps unique. There is the usual wide variation in the density and quality of the stand, owing to the difference in soil, altitude, and exposure. This variation is further complicated, however, by the thoroughly dissected nature of the topography, which is such that extensive slopes with fairly uniform conditions for timber growth are practically unknown, and even small tracts are almost sure to be cut up by minor hollows and ridges with every variety of soil and exposure. Thus travelling in a straight line across the topography, very frequent changes in forest type are encountered. Another difficulty consists in the large number of species and products to be considered. In making a recent estimate in West Virginia it was necessary to keep track of fourteen species of sawtimber, in addition to tanbark, black oak bark, cross ties, poles, posts, and extract wood. It is unnecessary to point out that the recording and computing of the tally is considerably complicated by the necessity of classification into so many items. The problems connected with the estimating of individual trees are not so different from those that are met with elsewhere, except that close acquaintance with many species is necessary, and the great variation in quality of the hardwoods makes proper allowance for defect often extremely difficult.

The "practical" cruiser who comes to this region from the North, especially from the Lake States, is likely at first not to realize what a large influence the sparseness of the timber on upper slopes and ridges has on the average stand per acre of the whole tract examined. Therefore he is apt to greatly overestimate, as some investors have found out to their cost. The local cruiser of the southern mountains ordinarily recognizes two qualities of stand, and makes the minor watershed his unit, following up each hollow and estimating the timber on it separately. He gives his attention chiefly to the valuable timber on the lower slope and cove lands, lumping off the remainder on an acreage basis or disregarding it entirely.

Beginning in 1911, with the passage of the Weeks law authorizing the purchase of land with the establishment of eastern National Forests in view, the Forest Service in carrying out the provisions of that act has done a large amount of timber estimating in the southern Appalachians. It is the intention to discuss the methods employed in this work and new adaptations which have proved especially valuable, rather than to present a complete treatise on timber estimating or to go into detail as to fundamentals familiar to foresters, except when especially applicable to southern Appalachian conditions.

QUALITY CLASS BASIS

The strip system has been adopted because it is very convenient for mapping and rough boundary location in connection with estimating, but, as modified in present practice, it does not in some instances differ very widely from a systematic and intensive sample plot system. It has been found best to follow the plan of the local cruiser to the extent of making the quality class, or, loosely speaking, the forest type, the basis of the estimate. Accordingly, four different classes are recognized: cove, lower slope, upper slope, and ridge, the topographic names expressing in a general way the normal situation, but the real basis being the merchantable height of the mature timber.[1] This is a useful classification, since it reflects definite grades of productiveness in the sites on which the quality classes occur, and affords a basis for comparison between different tracts. In most localities one of these classes is found on such a small proportion of the area that the work can be simplified by combining it with one of the others. In fact, it is nearly always possible to place the hardwood forests in three quality classes, and sometimes it is best to recognize only two for estimating purposes, even if additional subdivisions are mapped for soil valuation. Usually the valuable timber is concentrated in one of the types, although sometimes the slope timber is of unusually high quality on account of favorable soil conditions, or of exceptionally high value on account of containing tanbark or other special products. In some localities special types also occur which require differentiation in estimating as well as for silviculture; for example, the spruce and northern hardwoods at the highest eleva-

[1] Cove class contains mature hardwood trees averaging three 16-foot logs or better per tree; lower slope, two logs per tree; upper slope, one log; and ridge, less than one log sawtimber.

tions, and the hemlock slopes and yellow pine ridges at lower altitudes. It should be borne in mind that the object of this classification is to reduce the great variety of timber on the tracts to be examined, an average of which is a mere mathematical abstraction, to a number of relatively homogeneous stand classes each of which can be expressed by an average per acre that can be arrived at satisfactorily by a sample tally and checked by judgment. In cases where it seems best to make three or four "type" divisions as a basis for estimating the timber, the principles and methods are the same as where only two are recognized, although both field work and computation are more complex.

LOCATION OF STRIPS

The location of the strips depends on the distribution of the timber and hence on the topography. The usual plan calls for strips crossing the drainage lines approximately at right angles so that the tendency will be to include all gradations of timber stand. Sometimes it is necessary to parallel the main stream, in order to cross a series of large side branches. The strips are run from base lines, usually surveyed with compass and chain, and constituting a closed traverse in case this is justified by the size of the tract. The base lines must be located so that the strips need not exceed two to three miles in length, and as nearly at right angles to their direction as the ground permits. They ordinarily follow the principal divides or main valleys, taking advantage of conveniently located roads and trails. Sometimes a long, straight boundary line of the tract to be estimated, if not too difficult to follow on account of rough topography, underbrush, or dim boundary marks, will make the most convenient base line.

One of the most important considerations is the location of the strips in such a way as to tally a sufficiently large per cent of the entire stand to give a reliable average. Since two or more distinct stand classes are recognized, and a separate estimate per acre for each is obtained and applied to the appropriate acreage as planimetered from the map, the necessity of locating the strips so as to include an equal proportion of each type is obviated. In fact, it is often advantageous purposely to vary this proportion. In some localities it is best to follow the ordinary method of gridironing a tract with parallel strips a fixed distance apart. This is desirable when the valuable timber is distributed irregularly, as is the case

when spruce and some other special types occur, or when the cove and lower slope timber runs so high on the slopes that it is most convenient to continue the strips straight across the narrow belts of poor timber on the ridges. However, it is more usual to find the timber concentrated in the coves, separated by rather broad, sparsely timbered areas on the upper slopes and ridges, and under such conditions it is plain that the conventional system of parallel, equidistant strips is not economical. If the strips are run close enough together to give a good estimate of the heavily timbered cove stands, they will be much closer than necessary on the scantily timbered upper slopes and much time and labor will be wasted. The problem is to modify the system so as to tally a high per cent of the good stands, and a low per cent of the poor. This may be done by covering the entire tract with a regular gridiron system of strips 20 to 40 chains apart, as circumstances may require, and making an additional tally in the cove, or cove and lower slope, stands by one of the following methods:

1. Additional strips may be run between and parallel to the gridiron system. This is practicable only in rare cases where the coves are extremely wide, as in hollows of ordinary width it would involve a great waste of time in offsetting.

2. Zigzag strips may be run along the hollows, continuing on each course until the extreme edge of the type is reached, and then changing the direction so as to cross the hollow again. This method gives an additional tally of the good timber without loss of time in offsetting. It is adaptable to varying requirements, for a larger or smaller proportion of the type can be covered by increasing or decreasing respectively the angle between the courses. On the other hand, if it is desired to maintain approximately the same per cent in hollows of unequal width, this can be accomplished by making the change of direction at turning points small in narrow places and large in wide places. It is usually most economical to run the zigzag strips two chains wide, using a three-man crew. One estimator calls the trees on one side of the line and maps, while the other works on the opposite side and snubs chain. The compassman tallies, and runs a rough box compass traverse, giving the courses to the map maker. The most experienced estimators in the party should, of course, be used on the "zigzag" crew, since they are working wholly in the commercially valuable timber. Ordinarily, a 20 to 30 per cent tally

can be made most advantageously by this method. Its application requires judgment, in order to secure the most average sample, since the location of the strips is not strictly mechanical, as each course must be laid out as the chief of crew thinks best. On the other hand, it is much more likely to give a fair average than an arbitrary sample plot method, since the whole length of the hollow is traversed by straight lines the direction of which, within certain limits, is fixed mechanically. The important points in practice are to take care to reach the extreme limit of the type as mapped before changing courses, and to give proportionally equal representation to both sides of the stream.

3. A 100 per cent tally of the coves can be made by traversing each hollow, at the same time mapping the stream and type lines and tying in strip crossings. This method is especially applicable when the valuable timber is concentrated along drainage lines in extremely narrow and irregular strips, perhaps averaging one to three chains in width. However, in wider hollows, or when it is desirable to include a good lower slope type extending well up the slopes, it is much more expensive than the "zigzag" method. Furthermore, unless the estimators are very careful and conscientious in covering the ground, patches of timber are likely to be missed, since it is the tendency of the crew to stick close to the stream.

In all of the three methods, it is necessary to tie to the original gridiron system of strips covering the entire tract. Therefore on each of these strips it is customary to mark temporarily the points of crossing each hollow. This can be done conveniently by blazing a sapling or large bush with the pocket knife, and writing on the blaze with indelible pencil the date or strip number, chains from starting point, and initial of estimator. The mark is located on the road or trail, if any, or at the most conspicuous point near the stream. These marks can be very readily picked up by the cove crew, especially if it includes a man who was on the strip crew which made them, as can often be arranged.

The question might arise as to the danger of overlapping or omission through the failure of the men who run the regular strips to locate type boundary lines in exactly the same places as the cove crews. Any large discrepancy of this kind is not likely to occur with experienced men, especially when some are on both crews, and would at once be detected in comparing field maps. A slight error does not affect the

result appreciably, since the average for cove or cove and lower slope type is determined by the tally made by the special cove crews which in turn governs the map and acreage of the type; and the strip acreage on the inferior type is too large to be affected by errors of a few trees more or less at cove crossings, even if these did not compensate.

PER CENT OF AREA TALLIED

It is necessary to consider not only the location of the strips, but also the per cent of the total area to be included in them. The size of the units for which separate estimates are required, and the uniformity of the timber within the types or stand classes recognized, are factors, the effect of which upon the per cent of estimate necessary for a given degree of acuracy, is well understood. The smaller the estimate unit and the less uniform the stand of timber, the greater is the per cent of area which must be covered by the strips. For the valuation of tracts as a whole, this per cent varies inversely with the size of the tract, other conditions being similar. This is apparent when one considers, for example, that a five per cent estimate of a 200-acre tract means a tally of only ten acres of timber, which is of little value in determining the average of an irregular stand, while the same per cent of a 5,000-acre tract gives a tally of 250 acres, which is sure to be representative if the strips are well located.

When valuation is the sole purpose, it is not necessary to have as accurate an estimate of inaccessible tracts with low stumpage values as of relatively accessible bodies of timber with high stumpage values. Under such circumstances, accessibility increases the per cent of estimate necessary for a given degree of accuracy in valuation.

The following range of per cents, except in exceptional cases, will meet the conditions of the southern Appalachians, provided an estimate is required which will be within ten to fifteen per cent of the actual stand on the unit. A higher standard than this cannot be obtained under average conditions without prohibitive expense.

Area of estimate unit acres	*Per cent of Total Area Estimated*		
	Average of all types	*Heavily timbered types*	*Lightly timbered types*
0— 100	50—100	50—100	50 —100
100— 500	25— 50	25—100	10 — 25
500—1000	10— 15	20— 50	5 — 10
1000—5000	5— 10	15— 25	2½— 5
5000+	3— 5	10— 25	1½— 2½

METHODS OF TALLY

In addition to planning the strips as to both location and number so as to include a representative and sufficient sample of the timber, it is essential to estimate and tally the individual trees in such a way that their true content may be determined as accurately as possible.

The individual trees estimated on the strips can be recorded either in terms of the final products, as saw logs, ties, posts, or acidwood, or as trees of certain size the contents to be later determined by the application of volume tables. The first method is possible only when the estimator is very expert, and speed not necessary, and consequently has not been used except in exceptional instances in Forest Service appraisals. Under ordinary conditions, it is desirable to use the volume table method. When a large amount of work is to be done in a given locality, local volume tables, or modifications of general tables based on local measurements, may be made in a short time if satisfactory general tables are not available. The Forest Service has a set of volume tables for the principal species and products of the southern Appalachians which will give good results when applied with judgment and checked for the locality.

Saw Timber.

The part which the factor of top diameter (d.i.b. at the small end of the top merchantable log) plays in estimating sawtimber by a volume table method has been recognized.[2] It is important that the table used be based on top diameters corresponding to those of the timber as tallied in the field, especially in the case of one-log hardwoods, where the variation in this dimension is large. In estimating timber which runs short bodied, the writer has found it desirable in some cases to obtain enough measurements of one-log and one and one-half log trees to make local tables for those heights, even when the general tables were applicable to trees of the greater height classes.

It has been found convenient to tally trees containing sawtimber by d.b.h. 2-inch classes and number of 16-foot logs.[3] If the stand is on the whole short bodied, they may be tallied by half logs (8-foot lengths), without making too many columns on the tally sheet. However, it is

[2] See "Some Problems in Appalachian Timber Appraisal," by W. W. Ashe, in this issue of the Journal of Forestry, p. 322.

[3] An exception is made of spruce, which is tallied by d.b.h. and total height in 10-foot classes. This makes it possible to compute the tally in cords of pulpwood if desired, and is not inaccurate for sawtimber, since there is a more uniform relationship between merchantable and total height in spruce than in hardwoods.

customary to tally ordinary sawtimber to the nearest even log, as the compensation is practically perfect. All visible defects are allowed for in the field. A tree is butted off by reducing the tally of d.b.h.; defective parts of the trunk are eliminated by reducing the number of logs tallied. In addition it is sometimes necessary to make in the office a percentage of reduction for defects which can not be detected by the appearance of the standing tree, this per cent for each species being determined on the basis of experience of sawmills operating in the locality. However, it is in general most satisfactory to deduct in the field for all defect if there is any possibility of detecting it. In making these allowances, experience and close observation are called for.

Poles, Ties, and Posts.

Telegraph and telephone poles, hewed crossties, posts, and similar products are tallied by the piece in columns under the appropriate species. If the amount of pole timber is considerable, poles of different height are kept in separate columns. It is best to include sawed ties with the sawtimber, estimating the per cent which will go into ties with the proportion which will go into each grade of lumber. The number of sawed ties, if desired, can then be determined by a conversion factor. It is sometimes desirable to tally post timber by d.b.h. of the tree and number of standard post lengths, so that the results can be computed in posts of different sizes, or in terms of cords for insulator pin wood if desired.

Bark.

Chestnut oak and hemlock bark is often an important product which must be included in southern Appalachian estimates. Black oak bark in some sections is also coming into market at good prices at this time, and bark of other oaks must be reckoned with in some localities. Bark timber which contains no saw stock is recorded by d.b.h. in a "no-log" column under the species. Volume tables for chestnut oak bark are now being prepared in the Forest Service under the direction of W. W. Ashe. These will be based on d.b.h., total height, and quality class or "forest type." When no volume tabels are available, the "practical" cruiser's method of allowing one ton of oak bark to a certain number of trees can be used. Experienced bark operators can estimate this number very closely for the different stand classes in localities with which they are familiar. In computing black oak bark, it must be borne in mind that although this runs thinner than chestnut oak bark, the weight of a given volume is enough greater so

that there is not much difference in weight of bark between a chestnut oak and a black oak of the same size. Hemlock bark is usually estimated by the local cruiser on the basis of a ton to 2,000 to 2,500 board feet of sawtimber, but the use of a volume table is preferable.

Acidwood.

Chestnut acidwood, which is sold by the long cord (160 cubic feet, stacked), is also tallied in a "no-log" column, and the volume computed by estimating the number of trees to the cord or preferably by means of a volume table. When the market is good and the utilization close, there must be taken into consideration the acidwood in the tops of sawtimber chestnuts, and in the stems of trees which are only partly usable for saw stock. The tops may be lumped off at an estimated number per ton, or computed by special crown tables if these are available. When a tree contains both sawlogs and stem acidwood, it can be tallied in "no-log" columns with the trees containing acidwood only, and the sawlogs in a special column by diameter at small end. The amount of sawtimber tallied in this special column has to be converted to long cords and subtracted from the contents of the "no-log" column to arrive at the net amount of acidwood. Improved chestnut cordwood tables on the basis of d.b.h. and quality classes are also being prepared in the Forest Service.

FIELD PRACTICE

Organizations.

The standard organizations for strip surveys work out very well in the southern Appalachians. A party chief can supervise efficiently the work of three to six crews. Each crew is composed of two men, one to estimate and map, the other to run compass and tally. Three men can work together in doing extra estimating in the coves, as has been explained. The party chief can often make the third man on the cove crew, but when a compassman is released from field work by placing two estimators on a cove crew, he can always be used to advantage on computing or odd jobs in the office. The party chief can make his work most effective by delegating the business management of the camp to other members of the party, and devoting the largest share of his time to supervising the technical part of the work.

Width of Strip.

It has been found necessary to use special care in checking the width of the strip because of the frequent changes in the character of

the ground and cover. A fixed horizontal distance looks much longer on a steep slope than on the level or a gentle slope, and in small brushy stands than in large, tall, open timber. The estimator must continually check his judgment of distance by tape or pacing, or considerable errors are likely to result. Where there is not enough brush seriously to obstruct vision, the two-chain strip is more accurate than the one-chain in this respect, that the *proportion* of the trees close enough to the outside lines to be in doubt is not as great in the case of the wider strip.

Check Estimates

Check estimates are valuable not so much for checking the relative ability of the different estimators as to give them a chance to get together and compare notes on specific problems. On any short strip such as is practicable to run for check purposes, the best of estimators are likely to vary enough in their judgment as to the best utilization of a few doubtful specimens so that their results do not compare very well, although such variations would probably be compensated in the course of a normal day's work. Ordinarily, however, a strip but twenty chains long can be so located as to cover enough different conditions to give grounds for a valuable discussion among the estimators, thus promoting uniform work and correcting individual eccentricities. To get the greatest benefits, the individual tallies should be made first, and then the check tally on the same strip, all of the estimators participating in the latter. Careful check estimates are especially desirable in this region on account of the latitude as to the utilization of the chief species, which makes it difficult for a number of men, each working by himself, to estimate consistently with each other.

Records

Tally sheets about 8 by 10½ inches are as small as can be used to advantage in the southern Appalachians. It has been found desirable to rule these so as to give forty-nine vertical columns, separated by heavy lines into two groups of six columns, one of five columns, two of four and eight of three, the larger groups coming first. One group of columns is used for each species. The width of the rows and columns is varied so as to give the most space in the places where experience has shown that the largest number of tallies will be made. A small aluminum tally board, open at one end for inserting the sheets, is used by the Forest Service. While this has not proved entirely satisfactory,

especially in cold and wet weather, it has worked better than any other device which has been tried.

It is the practice to change tally sheets on type lines, and at the boundary of each estimate unit. The estimate units are usually natural logging units bounded by ridge lines. It is not necessary that each sheet be a record of a continuous tally, since the types may change so frequently that it saves time to use a single sheet for a number of short stretches of the same type in the same unit. However, it has been found best not to tally more than twenty to twenty-five chains of strip on one sheet, and to avoid throwing together widely separated portions of the same type. Each sheet is kept so that the location of the tally is clear. For permanent record, an index map can be prepared, showing in addition base lines, boundaries, monuments and reference points, the location of the strips and the exact position of each tally sheet. Then if each sheet has been scaled individually, the average stand in any particular part of the tract, even though not constituting a separate estimate unit, can be determined very easily by going back to the original sheets with the aid of the index map. Of course, there is no use of undertaking even the small amount of extra work involved in making such a map, if the estimator is certain that his results will be wanted only for immediate use and only in the units in which originally prepared.

COSTS

The Forest Service has used for estimating in the southern Appalachians parties consisting of estimators at \$1,100 to \$1,500 per annum, compassmen at \$35 to \$60 per month, and party chiefs at \$1,300 to \$2,000 per annum. The cost has varied from five to twelve cents per acre for tracts 1,000 acres and over in area, including office work in completing maps and reports. Smaller tracts have in some cases cost much more than this. They usually require much more boundary location and base line work in proportion to area than the larger tracts, as well as a higher per cent of estimate. In one case a tract of about 27,000 acres was estimated on a six per cent basis at a cost of six cents per acre, while to estimate separately an adjacent group of thirty small tracts averaging about 250 acres in area cost 19 cents per acre.

It is safe to estimate the cost of cruising a large tract on a five to twelve per cent basis at approximately one cent for every per cent of the total area covered. Of course, all other conditions being

exactly the same, the per cent estimated may be increased without increasing the cost in quite the same ratio. However, a more intensive cruise naturally calls for more careful base line and location work, and justifies more detailed computation, so in general the cost varies almost, if not quite, directly with the per cent of estimate.

FUTURE PROGRESS

It is felt that the methods of estimating in the southern Appalachians, while they may answer present needs, are still far from perfect. Undoubtedly new features of technique will be developed, and old ones improved. It would seem that there is a good field for advancement along the line of securing consistent accuracy. There is no use in getting the width of the strip accurate to a degree not justified by the character of the volume tables employed, or to carry the estimating of individual trees to a degree of accuracy not justified by the methods used to include in the strips a fair representation of the tract. Every estimator knows that theoretically all steps of his work should be done to approximately the same degree of accuracy, but how many can express quantitatively their margins of error in any one particular? A party chief in the Forest Service does not feel justified in using the time necessary to check each part of the work accurately enough to determine these, although valuable indications are obtained from the check estimates. At the same time, there is no way to obtain positive knowledge as to the standards of work which ought to be required without making many careful tests. At present, the securing of consistent accuracy is largely left to judgment, assisted very materially, it is true, by the results of check estimates. However, this would appear to be an important field for further research.

Of course, judgment and experience will always be very large factors in estimating timber, especially in the southern Appalachians. No development of technique can ever reduce the work to a merely mechanical process. The variety of conditions is infinite, but even if everything else could be made a matter of mehtod, the tally of the individual tree is bound always to call for judgment on the part of the estimator. But judgment and experience alone, without system, are not sufficient for securing reliable estimates at moderate cost. Continued progress in systematic methods is called for by the increasing value of timber in the southern Appalachians and consequent greater demand for reliable estimates.

SOME PROBLEMS IN APPALACHIAN TIMBER APPRAISAL

By W. W. Ashe

Forest Inspector, Forest Service

The decade prior to the panic of 1907 was marked by phenomenal appreciation in the values of Appalachian hardwood timber. Since this date and especially following the subsequent break in the price of yellow poplar panel stock, there has been stagnation in hardwood timber values, the increase in the prices, until early in 1916, being insufficient in many cases to meet its carrying charges. During this period of increment such forest properties offered excellent investmental opportunities; with the waning of this factor of value, profits have been limited practically to those of operation.

The result of this has been to develop in prospective operators in this region radically different views respecting the volume of stands as well as different concepts of merchantability. Standards of merchantability were still indefinite. While the timber was rapidly increasing in value and while its prices were still comparatively low there was little incentive for accurate determination of volume. Even though a stand failed to saw out as much as the estimate showed, it was expected that this shortage would be offset by the increase in the selling price of lumber if the operation extended more than a few years. With the elimination or reduction of the investmental appreciation, it has been necessary that appraisals of timber should be more accurate and that the engineering features on which exploitation are dependent should be so carefully determined that there would be practical assurance of profit in operation. Forest lands being acquired under the act of March 1, 1911, providing for eastern National Forests have been appraised by standards designed to secure these results.

Briefly the methods which have been followed consist (1) in placing a value upon the soil; (2) in determining the amount of the timber; and (3) in placing a value upon the timber.

Soil when it is regarded as absolute forest land, as is the prevailing condition, has been appraised on the basis of its relative capacity for growing timber. Small areas occur which are suitable for farming or for grazing, and these are so valued. There is such a limited sale of land of this character to private parties, that the prices involved, which

might be considered the best criterion, are comparatively ineffective as guides.

The value of land for growing timber is primarily predicated upon the heaviness and unit value of the stands, value being affected by the kind of trees, and logging costs; while subsidiary elements are damage to the soil by fire, the amount and character of young growth and the thoroughness of replacement. In determining[1] the amount of timber that which has merchantable value for present operation is segregated from that which has only a speculative or investmental value.

Preceding or preferably simultaneously with the volume survey, a lumberman ascertains the values (stumpage values per unit) of the different species and products. The so-called lumberman (in reality a stumpage-appraiser) must be capable of analyzing the quality of standing timber in order to determine its yield in grade of sawed lumber, as well as possess fundamental knowledge of forest engineering, logging, and milling. Reduced to its simplest terms, the operating value of standing timber is the difference between its selling price at the nearest market and the cost of exploitation including reasonable profits to contractors and operator. The market price of timber, due to ignorance on the part of buyer or seller or to speculative tendencies in the market, may be higher or lower than its operating value. The object of the Government's appraisal is restricted to ascertaining operating value. As a rule in considering a prospective purchase of timber land, the active operator gauges the probable mill run selling price of the lumber on the relation of his past sales. In a similar manner he approximates the operating costs. From such data he decides what he can afford to pay: data which is often fictitious from dissimilarity in conditions.

It is necessary in governmental appraisals to establish a more detailed basis. A plan of operation or development is prepared by the lumberman-appraiser. This plan may be limited to a single tract or it may embrace a number of tracts which form a natural operating unit. The scheme may provide for railroads, trams, flumes, slides, etc., team or machine skidding, a permanent mill or for portable operations or various combinations of these methods; the object being to make

[1] The method of ascertaining the amount of timber by means of the volume survey is briefly outlined in the footnote on pages 325 and 326, and more in detail in an article referred to in the footnote.

use of the most economical system and the one which will allow the maximum timber values for a logical assemblage of land. Such a period of operation[2] is worked out as will secure low fixed charges, a low rate of amortization of the initial investment in plant and transportation, but one which will not overtax the capacity of the logging system to supply the mill with timber. The cost of plants and the transportation system are carefully computed. The elements of cost of manufacture are determined in great detail and with as much exactness as possible. These, together with the overhead charges embracing amortization, salaries, and office expenses, interest and other carrying charges, determine the cost of the production, less profit and stumpage.

It is necessary for the appraisers to keep in touch with labor prices, with the cost of equipment, supplies, freight rates, and markets, as well as with the fluctuation and prices of lumber, and with trade conditions. Violent upward trends of prices and temporary prices of special grades and products, especially those of local markets, are neglected or are so combined as to secure averages for a year or longer period. Since the Government purchases are on an extensive scale, every effort is made to prevent its operations from inflating prices. When there is a sudden upward swing to the market for timber and speculation seems active, its appraisals are more carefully, almost cautiously, made. It can afford to defer and wait. There is no method of rectifying ill-considered acquisitions. Since it is expected that timber which is acquired will later be removed, the sales must be made

[2] The longer the period of operation, the smaller is the annual charge for amortization of the initial investment in the mill plant and in the transportation system. The shorter this period the lower in the aggregate are the charges against the timber and the plant investment and the larger should be the profits of the operation even assuming no increase in the selling price of lumber. Many an unprofitable southern hardwood operation would have succeeded had it been possible to log an overlarge mill to its full capacity and thus by shortening the period of operation reduced against the stumpage the per thousand charge of the enormous overhead load due to inflated values or arising from overestimate of the stand. The Appalachians are dotted with derelicts due to lack of unification of these principles: Overcapitalization of timber, too small a system of operation, and prolonged and consequently too high amortization charges. The Government has acquired many such properties, but the difficulties encountered in securing them as a rule have been those of negotiation rather than such as appertain to appraisal: the bringing of owners, often backed in their position by skillful and diplomatic agents, to realize that values are determined by market conditions and not by costs of reckless capitalization. Analogous to this is the futile holding of lightly stocked properties for price increment after the base has become too high for current appreciation in the value of timber to offset the current rate of interest on the holding price of the property.

at the then current prices of timber, and the sale prices cover certain carrying and administrative charges.

The Government has practically fixed the prices of certain classes of rough cut-over land. Six years ago such lands had no legitimate market value, and should the Government retire from the market, it is problematical what would again be their selling prices.

This outlines the general scope of Government appraisal. In its conduct, in addition to the major problems required in determining volume, in grading timber, and in engineering, the solution of which can be effected only by intimate knowledge, there have appeared certain minor problems. The methods of handling them may be of assistance to others who are interested in timber appraisal work. Some of these problems would seem to be peculiar to Appalachian forests and the economic conditions under which they are now being operated. The most important have been:

1. The adaptation of volume tables to closeness of utilization.
2. The correlation of volume cruise with lumberman's stumpage appraisal for different species.
3. The adjustment of intensity of volume cruise to local conditions.
4. The determination of grades and defect.
5. The appraisal of small trees.
6. Personnel.

Some of these problems the operator, trained in the region, disposes of almost intuitively; others are handled by his skilled employes; while some of the fundamentals are determined by him only upon the completion of the operation. Many engineering problems might be embraced in this category. These, in the case of Government appraisals, are carefully worked out for each case, the plan of development being adapted to suit the topography, the class of timber, and the size of the operation. While standardization of procedure is desired, every effort is used to prevent the employment of generalized figures.

There is, so far as my experience goes, no short cut either to volume cruise[3] or stumpage appraisal in the Appalachians. It is

[3] The usual though not the exclusive method of volume survey which has been employed is to gridiron a tract by parallel, chain-wide strips, evenly spaced, the distance apart determining the intensity of the cruise. All merchantable trees on these strips are measured, each species being tallied for saw timber by diameter classes and number of 16-foot logs; ties, poles and other minor products are also tallied. The stand, or volume in board feet, of the trees tallied for saw timber is then

probable that there are regions in which a universal volume table can be applied and mechanical methods used in volumetric survey, but such does not seem to be the case in this region at present. But given fair volume tables, such as a skilled volume cruiser can himself have prepared within a few days, the accuracy of volume results depends far more upon the capacity of the appraiser and cruiser than upon the method which is employed. Using the strip method as the basis of volumetric survey, it is safe to say that it requires two years for an untrained man, forest school graduate or otherwise, to qualify as an accurate cruiser, and even in this time unless he is adapted to the work and gives conscientious application his results show only a fair degree of accuracy.

In the more or less mechanical process of tallying the trees on the strips there are two sources of error which must be guarded

---

obtained by means of so-called tree volume tables which give the contents in board feet or log scale of trees of different diameters containing different numbers of logs and utilized to specified diameters at the small end of the top log. These volume tables are based on measurements of trees felled in logging operations employing different degrees of utilization. In connection with this cruise or survey, in order to facilitate determining the value of the soil for growing timber, the areas of the different forest "types" (classes of stands in which the trees will yield one, two or three 16-foot-long saw logs) are mapped.

Experience has shown that the most efficient crew for strip volume survey in appraisals of timber for eastern National Forests consists of two men. The forward man in the crew, a compassman who keeps the chain-wide strips straight and parallel, acts as tallyman for recording the timber data, changing the tally sheet whenever the forest "type" changes and hereafter changing it by small logging units as well. A surveyor's chain or tape for measuring the distances traversed on the strips and for obtaining the relative location of the topographic features on the strips as they are crossed is attached to his belt and drags behind him. His work is largely mechanical, but it requires from four to six months training for a man to become a compassman and tallyman. The rear man of this crew is the timber cruiser and is responsible for the timber volume. He attends to the rear end of the chain, calls the distances or "chaining," levels the chain to obtain accurate horizontal measurements of the distances where the surface is broken, and makes the cruise or measurements of the timber. He directs the compassman to record the kind of tree, its diameter, number of merchantable logs, and gives in addition for each tree such minor products as ties, poles, posts, and the data for determining the amount of pulpwood, tannin, extract stock, tanbark, and such other products as are merchantable. He indicates in his notebook the changes in forest "types" or stand classes, records the data for the skeleton map of the tract and in case a topographic map is to be made, he also records data for this, keeping track of the chainings as well as the compassman. In the examination of large tracts, several such crews are under a "chief of party" who has general responsibility for the work and usually prepares the report. A form submitted by him with his report, gives his associates and the different classes of work performed by each, and in connection with the tally sheets and their relation to the base line or periphery of the tract, permits the placing of the responsibility for the accuracy of the work on any portion of the tract. For a full discussion of the distinctive details of Appalachian timber cruising, see paper by R. C. Hall on "Timber Estimating in the Southern Appalachians" on p. 310 of this issue of the Journal of Forestry.

against, assuming as essential the accurate measurement of diameters. One is the number of logs (16-foot basis) in the trees, and the other is measuring the width of strip. The tendency of some cruisers is consistently to overestimate and of others to underestimate; the same is true of the width of strip. These errors consequently may tend to counteract. Check estimates on the work of individual cruisers made under supervision are required at regular intervals for the purpose of detecting any marked tendency to deviation in these directions, and men who persistently show too high a factor of error are considered suitable only for a compassmen and not volume cruisers.

The great obstacles to accurate and rapid work are the large number of species; it being necessary in many large tracts to record individually the saw timber and minor products from as many as twenty species of trees; the rapid changes in forest "types" or stand classes; the potent influence of relative attitude and aspect on value and merchantability of the same species; the great variation in the age of the trees within the same stand and, dependent thereon, the variation in quality and soundness of the timber; and the many kinds of defects, especially internal defects such as shake, wormholes, and old fire damage, which are local in their occurrence and which not only influence the quality and value of the timber but are often of such a nature as to exclude the timber from use as saw stock; the frequent roughness of terrain and occasional dense ericaceous undergrowth.

Adaptation of Volume Tables to Closeness of Utilization

Except in a few favored portions of the Appalachians where freight rates are extremely low and the cost of logging comparatively slight, or where there is a local market for low-grade lumber, it is impossible to operate at a profit the knotty logs from the crowns of many species. Poplar and basswood are among the few trees all logs in which can be considered merchantable irrespective of situation; but poplar is largely restricted to hollows and lower slopes. While in most operations knotty logs from other less valuable species can be handled when the trees are within a few hundred feet of the logging railroad, similar logs from trees less favorably situated are not merchantable and can not be moved in the next few years and should not be included in appraisal. This condition has necessitated

in practice the use of two sets of volume tables.[4] H. H. Chapman in a recent article[5] has called attention to the very point which it was necessary to consider in actual operations involving the use of these two tables, which is the top diameter on which the log volume table is based. Of the two volume tables employed one includes all timber which would be removed under the closest current utilization in this section; the other table, which is known in our practice as "One and Two Log Tables," gives the contents of butt and of the butt and second logs in trees which contain two or more logs; that is, it is based on larger top diameters than the standard tables. By using the butt and second log tables, only those logs are considered which are reasonably clear. The preparation of the butt and the butt and second log tables was in itself a comparatively simple matter; the difficulty has been the technique of determining the conditions on each tract to which each of the tables should apply. The conditions on most tracts are such that it is not necessary to employ two sets of tables.

Correlation of Volume and Value

If there were only one or even two species to consider, correlation of volume and value would not be a difficult matter, but with from ten to twenty merchantable species having different logging costs on account of difference in weight and hardness and having different values for the same trade grade of lumber, there must necessarily be extremely close cooperation between the lumberman-appraiser who determines the classes of merchantability and the chief of party of the volumetric survey or cruise in order to insure accuracy of results.

In the absence of such an understanding, stumpage values are likely to be too high and the estimated volume of merchantable timber excessive. This is the tendency rather than for the error in one to counterbalance the error in the other.

The lumberman-appraiser or engineer who develops the system of exploitation and determines the amount of different grades of lumber in the timber by species and stand classes has in mind the fact that logs of specific grades cannot be removed profitably except

[4] Circular letters; Volume tables, Mensuration, June 4, 1913, and June 11, 1913. The earlier letter called attention to the error in using volume tables having too small a top diameter; the second transmitted special volume tables based on a large top diameter and gave instructions relative to their use in connection with other or standard volume tables.

[5] Proc. Soc. Am. For., XI, 185, 1916.

over a certain and perhaps limited portion of the tract. He consequently bases his forecast of the average mill value of the lumber (from which he derives his stumpage value) upon the inclusion of only this small removable per cent of such grades of lumber (usually No. 3 common) in the mill cut. In case the volumetric cruise includes all of this grade of logs, this might add 5 to 10 per cent to the volume of timber on the tract. At the same time the lumberman-appraiser's stumpage values, based on the elimination of logs of this grade, may be from 5 to 10 per cent higher than would be the case had all logs of this grade been included by him in fixing his mill-run price. This results in a dual error; not only is the volume of the merchantable timber excessive but stumpage values are too high, the error in the result being the sum of the two.

There is but little difficulty in the elimination of entire trees of certain species from the volume cruise as the specimens become small on account of site or as logging costs increase. The experienced cruiser who has studied the conditions of the tract almost automatically does this even without having an operating or logging plan. His judgment may sometimes lead to the inclusion or to the omission of a few trees along a narrow zone which in the opinion of the lumberman-appraiser should have been given different consideration; but most men with two or more years' experience who are capable of acting either as chief of party or assuming responsibility as a volume cruiser can determine in a reasonable manner the profitable limits of logging in a section with which they are generally familiar.

The Adjustment of Intensity of Cruise to Local Conditions

Preliminary to beginning the cruise and before the base line is located, a general examination of each tract is made by chief of party to determine the topography of the tract and to ascertain whether the timber is uniformly distributed or in groups. It is desirable, so far as possible, that the strips should cross the salient topographic features either at right angles or obliquely, and should not coincide with drainage lines and crests or ridges. When the timber is uniformly distributed a cruise varying in intensity from 5 to 10 per cent is sufficient. When timber is in groups and particularly on small tracts, a cruise of such intensity is not sufficient, and it is necessary either to increase the intensity of the cruise over the entire tract by running the strips more closely together or by retaining a low degree of intensity over upper slopes

and ridges and increasing it, even up to 100 per cent, in the hollows in which heavier stands are located. In open timber it is not difficult to do this by chaining with care or sometimes by blazing the outer lines of the areas subjected to the more intensive cruise; in places, however, where undergrowth such as laurel or ivy is heavy, considerable difficulty is encountered in locating. A very careful chaining and close compass work is necessary to prevent much loss of time and the possibility either of skips or overlaps. In the case of tracts smaller than 100 acres a 100 per cent cruise is as a rule desirable and even necessary in order to insure accuracy.

The Determination of Grades and Defects.

In all cases stumpage values for each species are worked back from the mill-run grades of lumber. The determination of stumpage values from the per cent of the different grades of lumber which the timber will yield is complicated on account of the large number of species, and this complication is increased not only by reason of great variation in the size of timber on different tracts and sometimes on portions of the same tract, but also in many cases as a result of past culling having removed a considerable portion of the prime trees. General grade yields averaged from several mills are not applicable to particular tracts and it is equally inept to employ the grade yield of a nearby mill for a tract unless a careful examination of both tracts shows that the quality of the timber is the same. Mere propinquity is not sufficient to insure equal grade and value, though often relied on. The grade yield of lumber on each tract should be ascertained from the grades of logs in the standing trees with the same thoroughness as the volume. The best checks on the appraiser's field calculation of the per cent of grade volume tables for different species. Grade volume tables, however, are not infallible and must be so prepared as to be applicable for different conditions; that is, they must be based on quality sites as well as on diameter and age classes, thus requiring several tables for each species; and it must be possible to correlate the conditions under consideration with the appropriate grade volume table. Grade volume tables can be applied, however, only to normal, sound stands, and Appalachian stands are often aberrant.

There is little difficulty in making appropriate allowance for visible defect. Each tree showing it is discounted as tallied and it is in meeting

this problem that the experience and aptitude of the cruiser counts. In regard to hidden defect, the most disconcerting factor to be considered is old fire damage and subsequent insect and fungus deterioration. No grade volume table can be adjusted adequately to cover deterioration in quality from these causes; everything depends upon the judgment and capacity of the lumberman-appraiser and the cruisers. In addition to fire injury there are certain other classes of hidden defects which must be carefully watched for. The chief one is ring shake, the effect of which—in case there are several concentric shakes, the outer one near the sapwood—is to reduce to "cull" the grade of a large portion of the lumber in the tree so affected. In the butt logs of oak, much of the shaky lumber would grade as No. 1 common and better, and have a value as lumber more than twice as high as in the form of cull. The three chief causes of shake seem to be: swaying of trees on sites exposed to wind; winter freezing due to the peculiar climatic conditions of certain hollows and slopes where heavy freezing takes place while the wood is very wet; and the swaying of ice-laden trees in a sleet storm. There is no known means of judging whether the site conditions of a stand expose it to shake from either freezing or wind exposure. Old sleet damage, which is very prevalent in the Appalachian forests, can usually be detected, however, by mutilated crowns and by bowed trees of large size which are well aged. Evidences of this character require careful consideration on the part of the appraiser since they are almost sure indications of sleet damage and the frequently accompanying ring shake. Another accompaniment of sleet damage is worminess, the worms gaining free entrance through the extensive breakage of large limbs. Deterioration both from sleet and from frost may be restricted to a narrow belt, the timber both above and below being of normal quality.

Appraisal of Small Trees

Some tracts belonging to operating companies have been considered for purchase subject to the rights of the owners to complete the removal of the timber above a specified diameter over the uncut portion of the tract. In cases where the small trees, or some of the small trees which are not to be cut, are of merchantable size, it is necessary to appraise them. The determination of the relative costs of operating this small timber (as the basal step for appraisal) is so

involved that it has been treated in a separate paper.[6] When land and small timber are being acquired subject to the right of the owner to remove the larger timber within a definite period, they do not have the same value as would cut-over land from which the removal of the large timber had already been completed. The earning value of such land is greatly reduced or entirely negative until by the cutting of the reserved old timber it is possible for the small timber to grow over the entire tract. At the same time the old timber is receiving the benefit of protection against fire. Theoretically the price for a tract acquired in this status would be its value as cut-over land discounted at current rate of interest for one-half of the period of the timber contract.

Personnel

All-the-year-round cruising is hard work. Stations are frequently changed; the men have no homes or home life. This is particularly trying to married men. After two years, or about the time a cruiser should be efficient—should have learned something of logging costs and grades of lumber and have acquired considerable adaptability—he becomes keen, if not for office and administrative work, at least for some change in assignment. Any change seems to hold out more future than volume cruising. This unrest is alleviated as much as possible by securing, when conditions permit, slight or temporary changes in character of work and by employing such time as is not actually required in cruising in the preparation of volume tables. This, while affording a change in the character of field work, tends to qualify the men better for cruisers. Since the men engaged in the cruise are either new men or those who have not been selected for administrative work, they are often apt to allow the arduous nature of the employment to overshadow its responsibilities. During the past four years the value of lands approved for purchase has amounted approximately to a million and a half dollars a year. Each of the eight field parties engaged in the field examination of this land has been responsible for the valuation of lands amounting to approximately $200,000 a year. A chief of party who has been in continuous service for five years has consequently cruised land to the value of close to a million dollars—actually more than this, since a larger

[6] "Relative Cost of Operating Large and Small Timber." Forestry Quarterly, September, 1916. Southern Lumberman, December 23, 1916.

acreage is cruised than is acquired. The qualifications and responsibility for accurate cruising and appraisal are certainly considerably more than those involved in timber sale work. On timber sale work the questions of value, accessibility, and merchantability are eventually determined in any locality by the purchasers of the stumpage, and there is a gradual adjustment by that means. In appraising there are no basal data from which to start, but the status of each case must be determined individually, and it must be appraised at a price which will not only admit of its being purchased, but will yet eventually allow its profitable operation by a purchaser from the Government. Men who have been employed in this work are preeminently suited for carrying out timber sales. In cases similar to this, or wherever cruising work is to be continuous and it is necessary to train men for the work, it is profitable to employ men with the distinct understanding that they are to be used for cruising, and that their rate of pay as cruisers will be increased as their capacity for accurate work increases. A good commercial cruiser can readily command $10 a day, and since the entire success of an operation depends upon a knowledge of the amount and value of the timber, he is worth it. When timber is acquired on a close margin, he either makes or breaks the operation. The hundreds of business failures in Appalachian timber testify eloquently to the inadequacy of many commercial appraisals, and stress the desirability of developing and retaining men with a high standard of efficiency in this strenuous and exacting work.

RÉSUMÉ

The chief difficulties which have attended the appraisal of eastern mountain lands have consequently been those of personnel and technique, rather than of method. It is believed that other methods might be employed which would give practically as accurate results as the system used, though perhaps they would not be as flexible. The paramount consideration has been to secure the integration of the work by coordinating stumpage appraisals and the volume cruise. It has been due to the lack of such coordination of lumbermen that so many operations in the mountains of the southeastern states have not been successful. The stumpage appraiser in Government purchases fixes his stumpage value only after the elimination of grades lumber which cannot be profitably handled and of material which

can not be operated; the chief of the volume cruise, following the appraiser's working plan, includes in his merchantable stand only the material which the appraiser's working plan or notes indicate as accessible or merchantable, employing the table for obtaining volume which the particular degree of closeness of utilization renders appropriate.

A lack of stability in the personnel of the cruisers is a very important factor to be reckoned with. Unless there is an incentive among cruisers for regarding this work as permanent rather than temporary employment to be shaken as soon as something less arduous can be secured, it will be difficult to maintain that *ésprit de corps* which is essential for rapid and accurate work.

LOGARITHMIC CROSS-SECTION PAPER IN FOREST MENSURATION

By Donald Bruce

Assistant Professor of Forestry, University of California

While logarithmic cross-section paper has been in use for many years, its convenience for certain problems in forest mensuration has not been generally recognized. In fact, its use is so uncommon that a brief description may not be out of place. It is a form of coordinate paper in which the lines, both horizontal and vertical, are (like the graduations of a slide rule) spaced at logarithmic instead of at equal intervals. Since the number whose logarithm is 0 is 1, the origin or lower lefthand corner of the sheet is 1 instead of 0, but this 1 may have the decimal point at any convenient place, and may be called 10, 100, .1, or .01 at will. The paper is sometimes printed with graduations running from 1 to 10 only on both horizontal and vertical axes (or from 10 to 100, etc., if preferred). It is decidedly more convenient, however, if the scales are repeated at least once, thus giving a range of from 1 to 100. Figure 2 is drawn on logarithmic paper with the vertical scale repeated three times. Unlike the ordinary cross-section paper, the numbering of these scales cannot be modified, except for the shift of the decimal point.

The property of this paper which has been of greatest general utility is that on it a large number of equations, which when plotted on ordinary coordinate paper are curves, appear as straight lines. For example, an equation of the type

$$y = ax^{b}$$

may be written in logarithmic form

$$\log y = \log a + b \log x.$$

This, as a first degree equation, is when platted a straight line. Unfortunately, however, the laws which govern tree form and tree growth are apparently not generally susceptible of being expressed by equations of this type.

There are other properties of the paper, however, which render it of direct assistance to forest mensuration. These may be best explained by a concrete example, the preparation of the harmonized

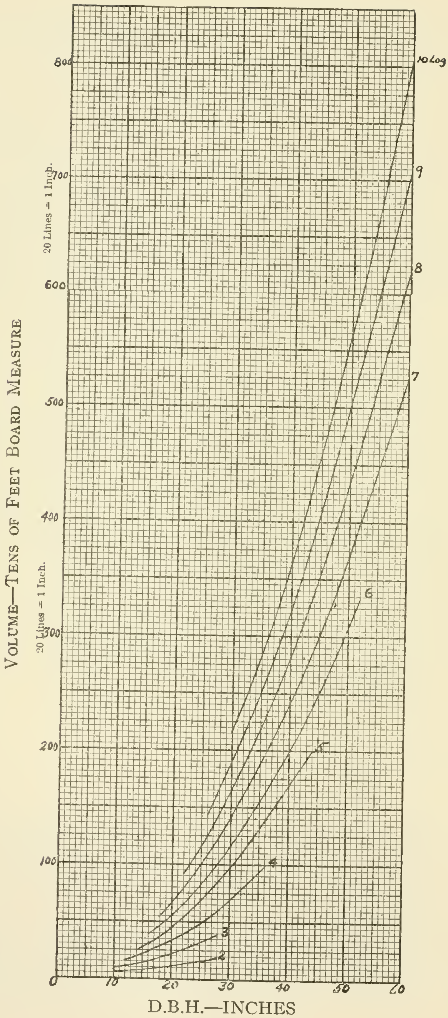


Fig. 1-A.

Height-class curves for Forest Service volume table for Douglas fir.

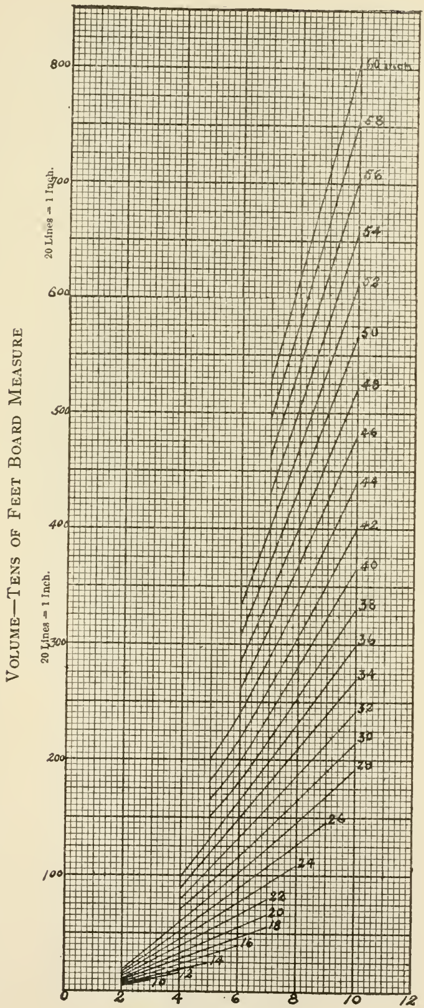


FIG. 1-B.

Diameter class curves of Forest Service volume table for Douglas fir.

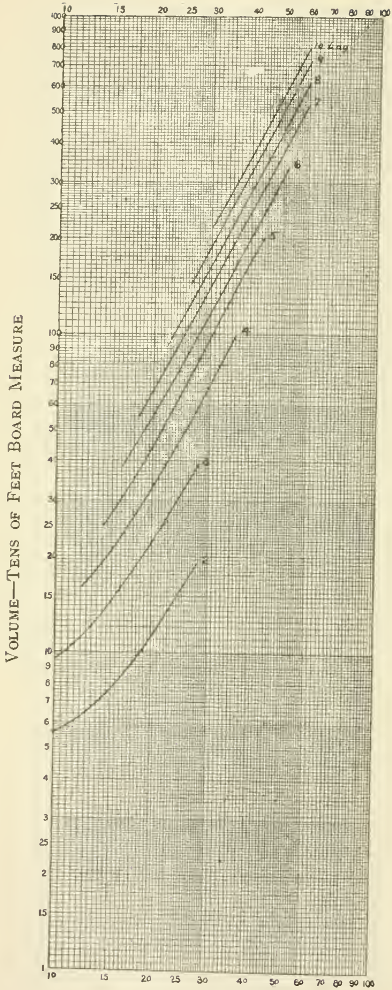


FIG. 2-A.
Height class curves of Forest Service volume table for Douglas fir.

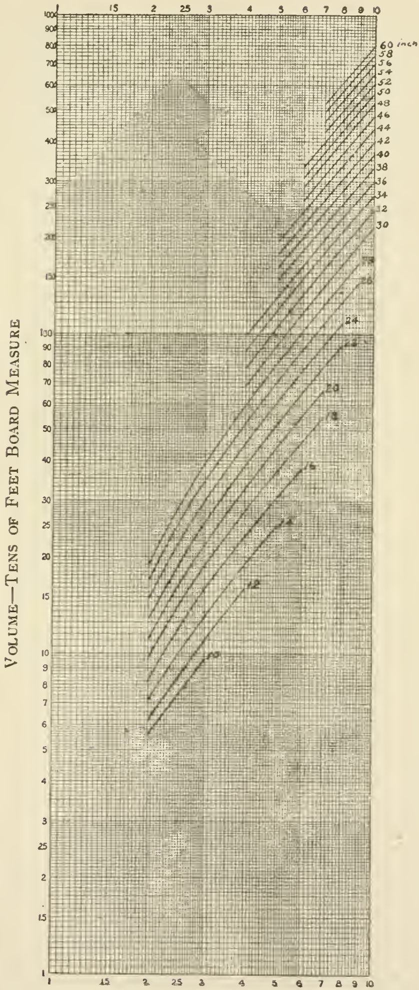


FIG. 2-B.

Diameter class curves of Forest Service volume table for Douglas fir.

curves of a volume table. One of the minor perplexities in this work is the selection of a scale which will not crowd together the smaller measurements and yet which will not unduly expand the larger. Figure 1, A and B, represents the two sets of curves (by diameter and height classes) read from a U. S. Forest Service volume table for Douglas fir. In figure 1-A the values are plotted exactly as they stand in the table, while in figure 1-B certain minor irregularities, which appear as the result of a failure to completely harmonize the curves, have been smoothed out. The charts are, of course, on a reduced scale to permit reproduction, but it is easily evident that the graph would have to be several times larger in order to give any facility in handling the lower curves of figure 1-B. This means a sheet which is decidedly unwieldy, and which affords much more space than is needed for the upper curves. Figure 2, A and B, represents the same curves on logarithmic paper. It will be noted that the lower curves here have more space, if anything, than the upper, and it is evident that a much smaller sheet can be used. In fact, in this particular case to obtain an equally wide spacing between the closest curves, figure 1-B would need to be some six times as large as figure 2-B.

A second advantage is connected with the number of digits which can be read. Principally as a result of the large-size graphs necessary with ordinary cross-section paper to secure proper curve spaçing in the lower diameters, it is all too common to find volume tables in which an absurd degree of accuracy is apparently indicated. Four significant figures implying an accuracy to within 1/100 of 1 per cent are all too common. Such an absurdity is almost impossible with logarithmic paper. The space between 91 and 92 and between 9100 and 9200 are identical, and the temptation to unjustified refinement disappears. An opportunity to go into unnecessary decimals in the case of the smallest trees is of course offered, but this temptation is more easily resisted. The contraction of the horizontal scale in the higher values is also entirely consistent with the accuracy to which measurements can be taken. The diameter of large trees cannot be as accurately measured as of small, and the lessened refinement possible in plotting is logical and desirable.

A third point of interest is involved in the shape of the resulting curves. If a straight edge is laid on the curves of figure 2-A, it will be observed that all of them are strikingly close to straight lines

except at their lower ends. The reason for this is obscure, but that it is not entirely an accident is indicated by the fact that a number of other tables which I have had occasion to plot have shown a similar tendency, although not always in such a marked degree. This fact is a two-fold advantage. First, the curves are easier to locate and draw, and second, if extensions are necessary, they can be more safely made. It may be objected that the diameter class curves of figure 1-B present the same peculiarity, and hence the same advantage. This is true in this particular case, but straight lines in the diameter class curves are of much less benefit. It is decidedly preferable to draw the height class curves first, since in this way the data are concentrated on the smaller number of curves, which will be more strongly located. It is in the location of these first curves that judgment has the greatest play, that the highest skill is required, and hence that the help of the straight line form will be most valuable.

There are many other cases where logarithmic paper will be found helpful. In growth problems, however, something a little different is demanded. Time is a variable which differs from such dimensions as height or diameter, in that it is determined, in forestry at least, either historically or by a process of counting instead of measurement. Long periods of time can be determined to a far greater percentage degree of accuracy than short. It seems illogical, therefore, to plot ages in such a way that the second century occupies no more space than the second decade. This situation suggests the use of a cross-section paper in which the vertical graduations are logarithmic and the horizontal are evenly spaced. Such paper can, as a matter of fact, be obtained under the trade name of "arithlog" paper. On this paper, as in the case of the logarithmic, certain types of equations appear as straight lines. In these, as before, the forester is but little interested. The only exception is that the compound interest formula

$$A = C(1.0p^{n})$$

and certain allied equations, comes into this class, since it can be expressed logarithmically as

$$\log A = \log C + n \times \log 1.0p$$

If $A = n$ are the variables, this is a first degree equation which can be plotted as a straight line. It will be noted that while A appears as

a logarithm, *n* does not, which is consistent with the type of paper we are discussing.

The significance of this is that if a growth curve can be plotted on this paper the slope of the curve at any given point will indicate the growth per cent at that point instead of the current annual growth, as is the case with ordinary cross-section paper. If it is desirable to bring this figure out numerically a series of straight lines radiating from the origin can be drawn, representing 1, 2, 3, etc., per cent. The slope of the curve at any point can be compared readily with these. These lines can be plotted with little trouble by obtaining a single point on the 1 per cent line by computation or from interest tables. If the 1 per cent line is then drawn with a straight edge, the 2 per cent line will have just double its slope, and so on for the other lines. All of them can thus be located by spacing off with dividers equal intercepts with any verticle line.

While this property is interesting, and is of some value in certain cases, the main value of arithlog paper is the same as that of logarithmic paper, that a more compact graph is secured, accompanied with consistent accuracy in plotting and reading high and low values.

Certain minor difficulties are involved in the case of both logarithmic and arithlog papers. In the first place, the converging scale may prove somewhat perplexing to the inexperienced. This difficulty is just that met with by the novice in handling a slide rule, and should be very transient. More serious is the fact that there is but a small variety of such papers on the market. While ordinary cross-section paper can be had in almost any conceivable size and spacing, I have been able to find but four or five patterns of logarithmic and but one of arithlog paper. Those available are, however, sufficiently varied to be entirely serviceable in solving many of the common problems of forest mensuration.

NOTE.—Instead of plotting cubic volumes of trees on the basis of diameter, they can be plotted on the squares of the diameters. Thus the ordinates would remain volumes, but the abscissæ would be the squares of the corresponding diameters. The advantages of this method are that ordinary cross-section paper can be used, and that, because they are plotted and read on an arithmetical scale, the plotting and reading of values is simpler. This is the method used by the Forest Service.—ED.

ECOLOGY AND SILVICULTURE IN THE SOUTHERN APPALACHIANS: OLD CUTTINGS AS A GUIDE TO FUTURE PRACTICE[1]

By E. H. Frothingham

Forest Examiner, Forest Service

Foresters have long held that silviculture is applied forest ecology, or, as they themselves would term it, applied silvics. The study of the forest as an organism had commanded their attention even before the general recognition of ecology as a distinct field for biological investigation. As the highest form of plant community life, the forest has afforded the most striking opportunities for ecological investigation and experimentation, to which foresters have, of necessity, not been blind. Ecologists may find in the general literature of European and American forestry, including the publications of the Forest Service, many real ecological treatises, though possibly under very prosaic titles.

Merely as an illustration of how ecology enters into the every-day life of the forester I wish to bring to the attention of ecologists the question as to the best handling of the southern Appalachian hardwood forest—the great remaining hardwood resource of the country, some of which now forms part of the eastern National Forests. Here is a case in which ecology is concerned, in a very practical way, with hundreds of thousands of acres and with a population running into the millions. The problem is how to utilize a complexly mixed and heavily culled and burned forest in such a way as to secure a natural reproduction of the more valuable species.

Before the management of this great forest can be attempted intelligently we must know more about the species and their habitats. This basic information centers around the selection of species for management as one of the first aims of silviculture. Such a choice must be based partly on economic considerations, but also, and most vitally, on the silvical qualities determining the relative aggressiveness of the different species common to a habitat, and their ability to produce heavy yields in pure or mixed stands. It is practicable here only to enumerate the principal factors of aggressiveness. They include the habitat relations and adaptability of the species, especially

[1] Presented at the New York meeting of the Ecological Society, Dec. 28, 1916.

in relation to soil moisture and temperature and to evaporation; their responses in rate of growth and reproduction, including the amount and fertility of the seed supply and its means of distribution; latitude of requirements as to seedbed conditions and climate during germination; susceptibility to frost, drought, and disease; and the capacity of the species to produce sprouts. A thorough knowledge of the behavior of each species under different light conditions at different periods in its life history and in the different habitats in which it is found is also exceedingly important, both ecologically, as a factor in aggressiveness, and, silviculturally, as a guide in determining the composition of the best mixture and the measures to be taken to secure the optimum growth. With this basic information in hand it will be possible to map out lines of silvicultural procedure far in advance of the present possibility of silviculture to put into use.

Silviculture in the South must some time become intensive, resting on the most systematic and carefully secured data. It is equally true, however, that at this time, when the Forest Service is inaugurating a timber-sale policy in the southern Appalachians, some immediate basis is necessary and must be formulated before cutting methods are put into effect. These two needs indicate two distinct methods of procedure. One is a long-time, intensive investigation of the factors affecting natural reproduction, accompanied by more or less empirical experiments. It gets its facts by measuring and experimenting with the known factors of the problems selected for study, and can be pursued to best advantage from experiment stations. The facts thus accumulated form the subject matter from which the laws of behavior of species and mixtures under given conditions of site and silvicultural treatment can be formulated. To reach these results entails much time and equipment, and trained investigators must be employed capable of grasping the essentials of the problems and of formulating and interpreting the facts and laws which can be reliably used as a basis for practice.

The other method consists of extensive, short-time series of observations of the effects of past cuttings with reference to reproduction. Superficial in a great many respects, it still supplies a means of "getting somewhere at once." It might be called an "ecological reconnaissance," but one which may supply just the data needed to build up an immediate, general silvicultural policy for the present handling of these hardwood timberlands. Such a study cannot yield very many or very

positive results, since the conditions which prevailed at the time of cutting and subsequently are only to be inferred from more or less debatable evidence. Still, by comparing the results of the studies on areas having certain constant features, this method may throw light on a few general considerations, and these may be all that are immediately essential to the needs of a practice which could not yet use more detailed findings, however reliable.

Accordingly, an observational study of past cuttings was undertaken by the Forest Service in 1915. The phases of the study were, briefly, (1) an enumeration, measurement, and classification of the significant forest vegetation of each cutting studied, usually of quarter acre sample plots; (2) a collection of all the facts and inferences obtainable by observation as to the period since cutting, the composition of the original stand, the modifying action of various agencies since the cutting, etc. In general it was aimed to make each of the plots studied tell what the forest was like before cutting, how the cutting affected composition and density, what came up as dominant young growth, what are its chances for success, and what method of cutting would have given better results, and why.[2]

In compiling the field data, the aggregate number per acre of trees of all the species was given separately for each class, and the percentage which each species formed of the total for the class was shown. It was hoped that by such comparisons between plots similar in certain respects, resemblances in the character of the reproduction could be discerned which would justify tentative deductions as to cause and effect. As a matter of fact, the variety of conditions found was such that the 45 plots studied in 1915 represent fully half as many distinct sets of conditions. The field data, therefore, are sufficient

[2] The form on which the field notes were compiled shows a separate tally for "original stand" and "present stand," on an acre basis. The composition of the original stand before cutting and the size of its trees was inferred by combining "holdovers," or trees left in logging, with the stumps, reducing all to a probable diameter, breasthigh, at time of cutting. In very old cuttings the species of some of the trees cut could not always be determined beyond question from the stumps, and it is possible that in some cases a few smaller or more perishable stumps had entirely disappeared or been covered by soil and humus. Since most of the cuttings were less than 20 years old, however, there was probably not very great inaccuracy from this source. The present stand was separated into "holdovers" and second growth; the latter, in turn, was divided into "Class I" trees, those in the upper crown cover, or which, through tolerance or position, seemed likely to survive for some time, and "Class II" trees, those which would never take an important place in the stand. There was a further distinction between "advance growth," or seedlings which struck root in the original stand before the cutting and "subsequent reproduction," or seedlings and sprouts which sprang up after the cutting.

as yet only to point to certain very general conclusions. A few more well-chosen plots will probably make possible a larger number of more specific findings.

The principal variables which affect all the problems may be classed under habitat, forest composition, kind of cutting, and subsequent history. These may be roughly classified as follows: Habitats are conveniently grouped under the commonly used terms of "cove," "slope," and "ridge" type, since this rough classification is sufficient to comprise the factors affecting major variations in composition. The kind of cutting varies from "clear cutting," in which close utilization was practiced and few large trees left standing, to light culling, in which only select trees of the commercially best species were removed. "Subsequent history" relates principally to the modifying effects of single or recurrent fires, grazing, and, occasionally, damage by wind or sleet.

Adequate description of composition cannot be given within the space of a short paper. In general the great oak-chestnut communities are characteristic of all the main types of habitat within the altitudinal confines of the hardwood forest; and chestnut, occurring from ridge to cove, is the most abundant species. The southern Appalachians lie within what has been described by ecologists[3] as the center of distribution of the deciduous forest. Their higher ridges and peaks bear a representation of the northeastern coniferous forest of spruce and fir (though the fir is an endemic species). Below the spruce and fir, especially on high northerly slopes and in coves, white pine, hemlock, and many broadleaf species characteristic of the so-called "northern hardwood" forest—notably, sugar and red maple, black and yellow birch, beech, and basswood—form mixtures very closely resembling the northern forest. In southerly coves and, in some regions, on slopes of all aspects, they mix in a great variety of combinations with the cove-inhabiting species of more typically southern distribution, such as yellow poplar, sycamore, buckeye, and cucumber. With these also are mixed chestnut, hickories, white, chestnut, red, scarlet, and black oaks, which often outnumber the more exacting species. The "ridge type" is characterized by a short, relatively open growth of scarlet, chestnut, black, and black-jack oaks, and chestnut, varied in places by

[3] Notably—Hershberger, John W. ('03), An ecological study of the flora of western North Carolina: Botanical Gazette, XXXVI, 241–258, 368–383; and Transeau, Edgar N. ('05), Forest centers of eastern America: American Naturalist, XXXIX, 875–889.

pure stands of xerophytic pines or pines mixed with hardwoods. The "slope type" is intermediate between cove and ridge in size of timber, and also in composition.

The prime object of silviculture in these diverse sets of conditions is to produce stands of the highest economic value attainable in each particular habitat. In intrinsic value, abundance, and growth rate the light-needing yellow poplar is without doubt the species most worth encouraging as the dominant species in the coves and lower slopes. Along with it come the rapidly growing black locust (intolerant), basswood, red oak, white pine, and cucumber (moderately tolerant); and the slow-growing white and chestnut oaks and hickories (moderately tolerant), and hemlock (tolerant). On the upper slopes and ridges chestnut, chestnut oak, shortleaf pine, and pitch pine give the greatest promise of future value. The species of less value which will have to be discriminated against include black, scarlet, blackjack, and Spanish oaks, beech, sugar maple, black gum, dogwood, sourwood, silverbell, and other small or slow-growing or commercially less desirable trees. These can never be entirely gotten rid of, nor, in fact, is this desirable. They all have some present and potential future commercial value; while in their proper places—beneath the crown cover, or as a cover to areas which would otherwise be bare—they may be very useful silviculturally.[4] It is in the competition on cut-over areas that they, along with such large trees of all species as are left standing, are most harmful.

Among the empirical results so far obtained by the study the most interesting relate to the cutting methods which seem called for to produce the best stands of the best species. Without taking time to back up conclusions by examples taken from the plot studies, the general silvicultural procedure suggested or verified by them may be stated as follows:

The encouragement of these select species means the control of the succession after cutting, either by some means of securing the desired reproduction under conditions favoring its development to maturity, or by selective cultural operations during the youth of the stand. Under present economic conditions the latter practice is hardly possible, although later on it will undoubtedly become so. The main

[4] In case of the extension of the chestnut blight into the southern Appalachians, several species of oaks inferior to chestnut in intrinsic value may grow immensely in silvicultural importance.

silvicultural aim at present must, therefore, be to secure the heaviest and most select reproduction at the outset. To a large extent, of course, this is a matter of seed abundance and favorable climatic and soil conditions at time of germination. Seed abundance is capable of partial control by timing cuttings to coincide with prospects of heavy seed fall of desired species. Once on the ground the success of the seedlings is jeopardized by the factors of competition, of which shade is apparently most important, and the more so the less the tolerance and growth rate of the preferred species. In a year or two after a clear cutting, for example, the ground may be so shaded by a low growth of rank herbs, black birch, sourwood, silverbell, dogwood, and sprouts and seedlings of the other less desirable species that a prolific crop of poplar seeds may be practically wasted. Barring destruction by grazing, some of the poplar and other intolerant, desirable seedlings will usually pull through, owing to their relatively rapid growth and the fact that during youth they are fairly tolerant. When the cutting is not clear, however, but leaves standing a great quantity of small trees and a few large, unmerchantable ones, the high shade contributes correspondingly to the suppressive influence and to the mortality of the poplar. If, on the other hand, all trees,[5] large and small, are removed just after, during or immediately before seed fall of select species, the conditions are good for the establishment of the desired crop on more than an equal basis with the weed species.

To advocate the utter clearing away of the forest, especially in the luxuriant coves, may sound wasteful and revolutionary. It means the girdling or felling of all trees too defective or too small to have commercial value, except for the few left for seedling purposes. It would destroy many thrifty young trees of desirable species, but it would also take the weeds, like red maple, black gum, silverbell, sourwood, and dogwood. The new forest would start upon a nearly equal basis for all species, but since the commercially best species which are intolerant are also, as a rule, those of rapid growth, their future development is assured. With the help which may be given them by cultural operations later on, the species will fall into their proper places from a silvicultural standpoint, the light demanders above, and the slower growing or small, tolerant species beneath.

For the ridges and upper slopes, the treatment indicated by the

[5] Except trees specially reserved as a seed supply.

study is no less extreme, but in the opposite direction. It is a program of *laissez faire*. The scrubby, often burned ridge forests are in need of rest and protection. Their inaccessibility and low quality make logging unremunerative at best. No cutting should be done in them ordinarily until such a time as they show marked improvement in thrift. Another consideration is the undoubted value of such stands for watershed protection and the regulation of run-off. Eventually we may hope to find conditions, both silvicultural and economic, favorable to the removal of many of these stands by some long-time method which will permit the growing of a new crop during the period within which the old is removed.

These are the large general aspects of silviculture in the southern Appalachians which lie within the power of a purely observational method of study to solve. The time will come, however, and possibly even before trees now started have reached their maturity, when we shall need to practice far more intensive forestry. We shall be sadly negligent if before this time silviculture has not at hand all the data needed for intensive practice, and to this end the intensive method of study must be used. There is no good reason why work along experimental lines should not be undertaken at once. The program of work should include first of all a thorough study of habitats, leading to their classification according, possibly, to the rate of growth of a chosen species or of several species upon each. The problems of relative tolerance of all species at different ages should be solved by measurement of light intensity and other physical factors in the forest on different sites. The fertility of seed, occurrence of seed years, and seed-bed requirements should be given continuous attention. The field for experimentation is very large, and, once started, the special direction in which the work can be of the greatest service will become clear.

COMMENTS ON TERMINOLOGY

In accordance with the suggestion of the chairman of the Committee on Terminology that those who find difficulty in accepting the committee's rulings should come forward with arguments for their own choice of other terms or of new terms, space is provided in the Journal for discussion of the proposed forest terminology. It is hoped that only through such a discussion forest terms may finally be accepted by the profession and a healthy growth assured.

Frothingham:

It seems to me that the term "crown density," as now used, is ambiguous, covering two closely related but still distinct conceptions: (1) crown closure, and (2) shade density. These two, together, comprise "crown density"; but I believe that the latter term will be much more comprehensible and useful if factored, in the nomenclature, into its components. Both "crown closure" and "shade density" can be expressed in tenths, if desired. The standard of classification of "crown closure" would be ocular or diagrammatic; that is, it would be a matter of estimate or of charting and measurement by means of planimeter, or otherwise. "Shade density" might be estimated on the basis of the difference between full light and the condition under heaviest shade, such as that of hemlock under pine or hardwoods; but I believe some photometric scale of classification must soon be worked out for it.

I would suggest a rewording of the term "crown density" and the introduction of the two new terms "crown closure" and "shade density," complete cross reference to be made between them. The definition of these terms would be as follows: (That for "shade density" was formulated by C. G. Bates.)

Crown density. The compactness of the crown cover of the forest, dependent upon (1) the distance apart, and (2) the compactness of the individual crowns. A loose term, combining the meanings of *crown closure* and *shade density* (cf.).

Crown closure. 1. The closing together of the crowns of trees in a forest, as in the youth of the stand. or after thinning.

2. Any stage in this process; by extension of the term, the proportion of the ground area covered by the aggregate vertical projection of all the crowns in the crown cover, regardless of whether these crowns may be expected to complete the closure. The degree of crown closure may be determined diagrammatically or by ocular estimate, and may be expressed by the following terms and decimal equivalents:

Closed—.8 to 1. G., geschlossen. F., plein.

Broken—.5 to .8. G., dicht. F., dense.
Medium—.3 to .5. G., lückig. F., entrecoupé.
Open—below .3. G., licht. F., clair.
See Crown density *and* Shade density.

Shade density. The complement of the percentage of light passing through the crowns, assuming unbroken light to have, at the time of measurement, a value of 100 per cent. The measurement is ordinarily taken at a standard height of 4½ feet, and represents the conditions of growth for reproduction at a lesser height. *See* Crown density *and* Crown closure.

Fernow:

The point is well taken, and a revision needed. There are, however, clearly three conditions involved:

1. Density of the individual crown, a biological factor, being in part specific, in part result of site. This appears to me well covered by the term "crown density." It remains to secure a photometric standard and grades for it.

2. Area shaded by crowns, a physical or mathematical factor, hitherto involved under the term "crown density"; perhaps best termed simply "crown area," the sum of the individual crown areas related to the unit of area in decimals, as customary.

3. The total shading efficiency, a function of 1 and 2 combined, for which, in order not to introduce a new term, "crown cover" would be an expressive term; a photometric cœfficient based on relative tolerance as standard would be necessary.

In this way, by merely more precise definition, the simple, old terms —*crown density, crown area, crown cover*—can be retained and the introduction of new terms avoided.

Frothingham:

Dr. Fernow designates three conditions:

1. Density of individual crown: term, crown density.
2. Area shaded by crowns: term, crown area.
3. Total shading efficiency: term, crown cover.

1 and 2 are the two components of 3. In other words, it is a factoring based on shading only.

Silviculturally there are two important aspects of crown cover: (1) interception of light, with respect to subordinate growth or forest floor conditions, and (2) mechanical and other interference between crowns in the crown cover without reference to subordinate growth. With respect to the first, the term "shade density," a resultant of the

crown densities of all trees of possibly many species in the crown cover, seems almost unavoidable; from this standpoint it is the shade (the complement of the light intercepted) of the entire crown cover which is the essential point. The second aspect does not necessarily concern the subordinate growth; it relates specifically to the competition, or freedom from competition of the crowns in the crown cover, and has a variety of uses in stand description, as when a stand is thinned to ".8 of perfect closure" (indicating that .8 of the total space is filled with three crowns). Its meaning is the same for aspen as for spruce. It affords a necessary means for describing the distance apart of the tree crowns when the sense of shading is either not important or so important as to require separate description.

I do not believe that these two meanings are sufficiently distinguished and provided for under the definitions suggested by Dr. Fernow.

Under "crown density," emphasis is correctly placed upon the "density of the individual crown, a biological factor," etc. I believe, however, that this should be only one of two definitions to come under this term, the second to be that given for "crown density" in the original criticism. This is because "crown density" is an established term referring to the crowns of the aggregate trees in the forest, and it is necessary to retain the term as a matter of reference. In its old sense it was, of course, "a loose term, combining the meanings of crown closure and shade density."

As to the proposed terms, "crown closure" and "crown area," the latter seems to me less desirable, because it does not convey the dynamic sense of coming together, a sense which it will be useful to regard in many cases; "area" smacks of mathematics, where a biological significance may be more important; while the crown *area* vertically projected on the forest floor is a means of denoting the degree of closure, the closure may be important in three dimensions, or within a certain range of depth of crown as well as width. Furthermore, to say that crown area is the "area shaded" (as indicated in Dr. Fernow's definition) seems inapplicable because of variation in the shade cast by crowns, dependent upon season, time of day, latitude, and length of crown; it is rather a matter of vertical projection of the crowns upon the forest floor.

I do not believe that the term "crown cover" has the implicit meaning of "shade density," while I do believe that the latter term conveys this meaning unmistakably. Finally, "total shading efficiency" is not

the only object to be sought (as above shown) in factoring the original term, "crown density."

To repeat, the factoring of "crown density" is not merely for the purpose of distinguishing the elements of "total shading efficiency" (that is, (1) individual crown density and (2) distance apart of the crowns). In common use the more important object is to differentiate between the interception of light by crowns, on the one hand, and the degree of separation of the crowns with reference particularly to mutual interference but also for mere descriptive purposes, on the other.

Fernow:

A brief rejoinder to the above might be made as follows: Is not the description of crown conditions in every respect, in the end, merely to answer the object of judging, for whatever purpose, light conditions, *i. e.,* interception of light-shading efficiency, the mechanical interference of crowns with each other being also of moment only on account of interception of light?

The decimal or percentic statements hitherto in use under the term "crown density" (which comes very near the above (2) definition of "crown closure") did not really mean more than the crown area; remaining silviculturally, and as regards shading efficiency, meaningless unless related to a given species.

The advocated restriction of the term "crown density" to condition of the single crown seems a simplification when another term, as *e. g.,* "shading efficiency," may be used to describe the area of all crowns, the crown cover.

All these terms are vague as long as we are lacking standards by which the different conditions are to be gauged.

More light on the situation is desirable.

NOTES AND COMMENTS

Concerning Criticism

The other day the writer was reading Brander Matthews' "Fascinating Life of Molière." Matthews drives home with convincing force the magnitude of Molière's contribution to French literature, because of the justice and piquancy of his constructive criticism of French manners and customs of the seventeenth century. Yet Molière unquestionably suffered from the enmity of those whose customs he attacked, and to such an extent that Matthews drew the conclusion that:

"Any attack on the exaggeration and excrescence of a movement cannot fail to have the appearance of an assault on the movement itself, since contemporary opinion is rarely able to disentagle the essential from the nonessential."

Does this not hold true of any criticism of conservation? Surely it is possible to distinguish a mere disagreement with specific policies and lack of loyalty to the splendid movement itself. If so, should criticism be encouraged or discouraged? Then, too, there is the personal element. Cannot a criticism of methods be made without involving the unpleasantness of creating needlessly a host of personal enemies? What set me to thinking along these lines was the statement of a friend of mine. A young forest student, with commendable zeal, had written a rather interesting criticism of a current Forest Service publication. At my suggestion, he showed his review to this friend of mine, who advised the student strongly against publishing it under his signature, for fear he would be "queered" with the Forest Service, because he, so youthful a forester, dared to criticise one of its publications. I asked a member of the Forest Service whether such a thing could be true; whether, if a young fellow published critical review, it would injure his standing with members of the Forest Service. To my gratification, the official replied vehemently that the fellows that composed the organization were all of a far different type. He took the position that a fairly written review, however critical, would not hurt the young forester's standing; that it would be judged on its merits, and if criticism was warranted the review would be accepted without rancor. It seems to me that such a viewpoint is so logical, so reasonable, and so essential to a proper development of forestry in the United

States that it would unquestionably be the viewpoint of those who control the destinies of the Service. If the opinion gained credence that the Forest Service could not be criticised (without danger of having this criticism misunderstood), it would be most unfortunate. No organization can be perfect, and so far as my own experience goes the Forest Service has been unusually broad in its attitude toward criticism, with possibly one or two notable exceptions. Let us be certain, however, that criticism, if directed at an organization (which has done and is doing so much good in the United States in exemplifying what an efficient departmental administration should be) or against its policies, shall be constructive and not merely destructive. It is in some respects unfortunate that members of the Forest Service themselves cannot express (as frankly as they wish) their own personal views of important policies. If they do so, even within the sacred walls of the organization, too frequently, their loyalty is questioned. Surely a man can be loyal to any organization and yet have the right to express himself, even if he cannot agree with the policies that for the day have the approval of those in administrative charge.

T. S. W., Jr.

Yellow Pine Cuttings in the Blue Mountains

The proper silvicultural method of cutting in yellow pine is one of the most important forest problems. A report recently completed by Mr. Weitknecht, resulting from his two seasons' field study of old yellow pine cuttings in the Blue Mountains, makes available a large amount of interesting facts and conclusions bearing on this problem. When the study was begun such practical questions as the following presented themselves:

1. How great is the windfall danger in cut-over stands? With such violent storm winds as occur in eastern Oregon, is there danger of all the trees in the reserved stand eventually being blown down, as was feared from the recent alarming windthrow in timber sale cuttings on the Whitman National Forest?
2. Does the dense reproduction which exists after cutting, as reflected by old cut-over areas, start before cutting or subsequent to it? What is the relative abundance and rate of growth (and thus the importance) of advance as compared with subsequent reproduction?
3. Does the accelerated growth which occurs in the trees left standing after selection cutting so materially increase the volume as to

become an important factor in the cutting method? Is it possible that it will appreciably shorten the rotation?

4. What is the effect of fire on cut-over stands? If clear cutting is practiced, where there is adequate advance reproduction and a severe fire later destroys all this reproduction, will the scattered little bull pines which may survive be sufficient to restock the ground?

The field work of the study was carried on almost entirely on old cut-over areas in and about the Whitman and Minam National Forests. The cut-over forest, and not the virgin forest, was studied, because, obviously, the factors which affect the managed forest are those prevailing chiefly under cut-over conditions. Fourteen separate cut-over areas, ranging from 5 to 50 years old, were visited in the course of the field work. On these areas sample acres were laid out in stands where different percentages by volume were left standing from 8 to 53 per cent. Altogether 24 sample plots were taken, and on them the radial growth for the last 60 to 100 years was gotten from 400 trees by using an increment borer. Reproduction was principally studied by running arbitrary lines 10 and 20 chains across cuttings and taking square rods every chain, on which all the seedlings were tallied by age and height. In this way the reproduction on 99 square rod quadrates was examined. Windfall was investigated on 15 and 20 year old cuttings by taking large sample areas, 20 and 40 acres in size, and classifying all the thrown trees by diameter, height, and the year after cutting when thrown. In determining the effects of fire, five private burned-over cuttings, from 30 acres to 400 acres in extent, were studied, and in a timber sale cutting a 40-acre area on which the brush was burned in piles was examined.

From a correlation of the data collected in the field the following results were obtained:

With regard to accelerated growth

1. The trees left standing in a selection cutting experienced a very pronounced accelerated growth, which takes place from 100 to 300 per cent faster than the growth before cutting, and which continues for 30 to 40 years following cutting.

2. The rate of accelerated growth bears an inverse relation to the per cent by volume of the trees reserved; where 10 per cent is reserved the increased growth is 290 per cent faster than the growth before cutting, and where 50 per cent is reserved it is only 75 per cent faster.

3. Accelerated growth is best secured where the reserved trees are

evenly distributed; where they are arranged in big groups the increased growth is very slight.

4. Healthy crowns produce accelerated growth abundantly, whether the trees have been dominant or suppressed, but all trees with imperfect and unhealthly crowns produce practically no increased growth.

5. Accelerated growth normally begins two years after cutting, lasts 30 to 40 years, and has a regular life habit.

With regard to windfall

1. Wind storms severe enough to throw trees in cut-over stands occur periodically, perhaps as frequently as once every four or five years, and these storms occur universally in the eastern portion of the Blue Mountains.

2. Heavy selection cuttings in which only about 8 per cent by volume of the trees are left standing suffer as greatly from windthrow as lighter selection stands in which 25 or 30 per cent are left standing.

3. A heavy windthrow probably takes place in most selection cuttings in the Blue Mountains, which in 20 years may amount to as much as 25 per cent by volume of the entire reserved stand. Of this windthrow the greatest per cent by volume of the trees are blown down by the first severe wind storms which strike the stand immediately after cutting. In this way 60 per cent of all the trees which are blown down in 20 years may be thrown in the first five years following cutting, and the remainder thrown in rapidly decreasing percentages year by year until 15 or 20 years after cutting, when the windthrow becomes normal, or about what it is in the virgin forest.

With regard to reproduction

1. Yellow pine reproduction on cut-over areas in the Blue Mountains is remarkably abundant and well distributed, and is amply sufficient for adequate reforestation.

2. On cut-over areas, as a whole, advance reproduction is more plentiful than subsequent, both in total number and number of dominants.

3. Subsequent reproduction grows two or three times as fast as advance reproduction in the virgin forest, but advance after cutting increases its height growth, and in most cases maintains its lead over the rapidly growing subsequent.

4. Malnourished or suppressed advance reproduction recovers after cutting, and where the cutting is heavy enough a high percentage of it makes thrifty reproduction.

5. The reserved stand seems to have very little effect on the abundance of reproduction, and its effect on the growth and vigor of reproduction does not appear to be serious when the stand is below 30 per cent, but under a heavier reserved stand the reproduction grows much less rapidly.

With regard to fire

1. Of the fire-burned cuttings studied, the fire was so severe on three of them that it wiped out absolutely all of the reproduction, and on the other two it killed 50 and 90 per cent.

2. On two of the burned areas the fire killed all the seed trees (two and six per acre, respectively), and on the other three areas, where two or three trees had been left, it killed only a portion of them.

3. Natural replacement is slowly taking place on all of the areas, but only by slow, incidental seeding from such inferior cull trees as escaped the fire and from trees 10 and 15 chains away on the edges of the burn. Stocking adequate for reforestation is doubtfully present on three of the burned areas, and two of them, which are 7 and 14 years old, are still practically denuded.

4. On the timber sale area, where the brush was burned in piles, the lower third or half of the crowns of small bull pines close to the piles had been killed by the heat and flames from big or intensely burning piles.

It is evident that these findings of the study have the greatest value in determining the best silvicultural method of cutting yellow pine, and many of them have immediate application in present timber sale practice.

In the case of accelerated growth the important practical value lies in the knowledge that its occurrence produces a yield at the end of the cutting cycle which is greatly in excess of that predicted by the present yield tables. Another point is that accelerated growth is best secured when the reserved trees are evenly distributed, and it is abundantly secured when they make up from 20 to 30 per cent by volume of the original stand—as is the present practice in eastern Oregon. The maximum accelerated growth can be obtained under these conditions if the marker selects for reserved trees only those with thrifty crowns and those which will receive the greatest liberation when their neighbors are cut.

With regard to windfall, it is reassuring to note that the heavy loss is more than offset by the accelerated volume growth. On one representative acre the increase in volume in the reserved stand was 43 per cent in 20 years, and the heaviest loss through windfall recorded in this study for the same length of time was 22 per cent. The windthrow danger is, nevertheless, exceedingly serious, and that part of the risk which is in the power of the marker to control should receive the most careful attention on his part. Since the study indicates that the bulk of the heavy loss occurs in the first five years, it might be feasible to pro-

vide tentatively in timber sale plans for the removal of the windthrow timber at the end of four or five years. Also, as the present knowledge of windfall is enlarged, it may be found that excessive windthrow is confined to certain areas. In such a case, a special adaptation of the cutting method might be practiced—a method in which only the smallest trees and young bull pines are reserved.

In the case of reproduction, the most valuable finding from a pracitcal standpoint is that advance is, as a rule, more abundant after cutting than subsequent, and that it increases its growth and vigor, and even the poorest of it recovers from suppression. Advance should, therefore, be protected with the greatest care in logging, and particularly in brush burning. Because of the increase in height growth and in vigor stimulated by liberation, advance reproduction should be favored as much as possible in marking.

The conclusions with regard to fire find their chief application in connection with slash disposal. They indicate that reproduction is very easily killed by fire running in the grass, as well as fire running in slash. They show that the heat, as well as the flames, from intensely burning brush piles kills the reproduction within a considerable radius surrounding the pile, and also kills the lower parts of the crowns of small bull pines close to the pile. Forest officers should bear in mind the terrible destructive effect of heat (not flames) in killing the needles and the cambium of both the smaller branches of trees and the stems of seedlings.

Two important pieces of legislation were passed by Congress on March 4, namely, an increase of $300,000 in the appropriation for the investigation and eradication of the white pine blister disease, and amending the Federal Horticultural Act to enable the Federal Horticultural Board to declare effective quarantine in tree and plant disease by districts, States, or sections of the country. The existing law was ineffective, inasmuch as it permitted a quarantine only where there is danger of infection.

Advance information by the Forest Service makes the probable lumber cut for 1916 around 11 per cent above that for 1915, or over 42 billion feet; that is, within 3¾ billion feet of the record year 1907.

In regard to woodpulp consumption, 160 mills figure in the preliminary statement, with 3,419,000 cords, of which around one-third was made by mechanical process.

In the strenuous effort to advertise and at the same time rationalize the use of wood, the National Lumber Manufacturers' Association is issuing a bewildering multiplicity of serial literature. Not less than four different series of publications reach our desk, namely, News Letters, Farm Bulletins, a Better Buildings Journal, and Engineering Bulletins. We have from time to time made references to these publications as usually sound and informatory woods literature. The latest (January, 1917) is a Farmers' Bulletin, No. 7, which gives detail information as regards construction of *Dairy and General Purpose Barns,* other such farm bulletins having discussed Implement Sheds, Grain Storage Buildings, Poultry House Construction. The Better Buildings series, first number, issued in November, 1916, gives advice as to garage buildings.

Under the lead of the Massachusetts Forestry Association, a bill has been introduced (H. B. 1413) in the Massachusetts legislature asking for an appropriation of $60,000 to control the white pine blister disease, to be expended under the State Board of Agriculture by the nursery inspector of the State, besides $5,000 to be expended each year for experiments in the line of control. It gives the right to the inspector to destroy infected Ribes or pines, compensation for destruction of cultivated, not infected, plants being provided, to be determined by a board.

The seventh annual meeting of the North Carolina Forestry Association was held in Raleigh, North Carolina, January 24 and 25. Governor Bickett, in his welcoming address, assured the association of his sympathy with every reasonable effort to preserve the forests of the State.

Addresses were made by Dr. Job Taylor, president of the Halifax Paper Corporation, accentuating the need of fire protection and closer utilization of waste material; by J. G. Peters, on the need of appropriations to carry the good fire law of the State into force; by Dr.

L. B. McBrayer, outlining reforestation work proposed to be carried on in typical cut-over longleaf pine on State lands. The white pine blister rust came in for consideration by S. B. Detwiler. Mr. W. R. Mattoon discussed the farm forests of North Carolina.

Resolutions were passed asking the legislature to appropriate funds for forest fire protection, urging the passage of the State-wide stock law, and indorsing the bill for the creation of a State game commission. Congress was also asked to approve the treaty with Canada for the protection of migratory birds, to continue its assistance to the States in fire protection, and to make an appropriation for the suppression of the white pine blister disease.

The State of Washington is one of the six States which has two public institutions at which forestry is being taught, namely, at the State University at Seattle and at the State College at Pullman, both conferring degrees. Lately, by legislative act, permission to confer forestry degrees was withdrawn from the latter institution, and while the teaching of the subject will be continued, it will be limited in scope, while the work at the University will be broadened.

The Upper Ottawa timber limit owners have joined the Lower Ottawa and St. Maurice Valley Protective Associations to the extent that now over 30,000 square miles of the timberlands in Quebec are under systematic fire control, Mr. Arthur H. Graham being the manager. It is expected that the Provincial Government will come in for patrol of the unlicensed crown lands of the region.

Wood prices in Switzerland in December, 1916, were 50 to 65 per cent higher for conifers than at the same time a year before, and for beech the increase was 25 to 45 per cent.

American Conifers Cultivated in New Zealand

Mr. T. W. Adams, a valued correspondent, living at Canterbury New Zealand, has published in The Transactions of the New Zealand Institute (Vol. XLVIII, 1916) a most interesting account of "The species of the genus Pinus now growing in New Zealand." Other

species of American conifers successfully grown there are described by Mr. Adams in a recent letter. Mr. Adams has for a great many years been interested in the growing of conifers and various species of oaks of the world adapted for growth in New Zealand. The American conifers he planted there from 12 to 50 years ago are growing thriftily, and many of them are now producing crops of fertile seed. They comprise altogether some 38 different species, of which 26 are from western United States and 12 from the East. The pines include Pinus strobus, P. monticola, P. lambertiana, P. flexilis, P. aristata, P. banksiana, P. contorta, P. virginiana, P. muricata, P. resinosa, P. radiata (= P. insignis), P. coulteri, P. jeffreyi, P. ponderosa, P. echinata, P. palustris, P. rigida, P. taeda, P. attenuata, P. monophylla, P. edulis, P. parryana, P. sabiniana, and P. torreyana. Among the miscellaneous conifers are: Abies balsamea, A. fraseri, A. grandis, A. concolor lowiana, A. concolor, A. magnifica, A. nobilis, A. amabilis, A. venusta, Picea canadensis, P. mariana, P. sitkensis, P. engelmanni, P. pungens, and Pseudotsuga taxifolia. With the exception of Picea sitkensis, all of these conifers have remained healthy and vigorous, apparently without being attacked by any fungus disease or insect pests. Picea sitkensis thrived perfectly for the first 20 years of its life there, following which it has become seriously injured by the red spider.

G. B. S.

Juniperus Cedrus

An interesting and possibly desirable addition for planting in subtropical and tropical portions of the United States is the Canary Island Juniperus cedrue. This tree is an exceptionally fast-growing one, capable of enduring most trying climatic conditions characterized by hot days and extremely dry air, with no rainfall during the large part of the year. It endures several degrees of frost successfully, but probably would not live outside of our cultivated citrus belt. The vertical range of this tree in the islands of Tenerife and Palma (of the Canary Islands group) is from 1,000 to nearly 8,000 feet elevation. The largest trees are produced at the lower elevation, while at higher elevations the plant assumes a shrubby form. Juniperus cedrus belongs to the group of junipers of which J. communis and the well-known cultivated J. oxycedrus of Spain and Portugal are examples, trees which

are characterized by long, awl-shaped, spreading leaves in contrast with the group of junipers which have small, scalelike leaves similar to those of our Juniperus virginiana. Some measurements of growth just received from Dr. George V. Perez, of Tenerife, are interesting. The average height at the present time of trees planted in 1906, now 10 years old, is 30 2-3 feet, with diameters ranging from 3 to 6 inches. The trees are planted in a close stand (6 to 8 feet part), which probably accounts for the remarkable height growth and small diameter development. The heartwood of this species is brownish, and has remarkable durability, and it is believed that cultivation of the tree in this country might be desirable for post timber. A small quantity of seed recently obtained from Dr. Perez is to be given an experimental trial in Florida and in southern California.

G. B. S.

REVIEWS

Reforesting Pennsylvania's Waste Land: What and How to Plant. By W. G. Conklin. Bulletin 15, Pennsylvania Department of Forestry. Harrisburg, Pa. 1916. Pp. 34.

This bulletin, written for the information of would-be planters, gives on 34 pages, based upon the experience of the State Department of Forestry, an account of what and how to plant, and how to obtain planting stock in Pennsylvania.

Of the forest area of 7.5 million acres not less than 5 million are in nonproductive condition, which can be made productive only by planting. In addition, 2 million acres of waste farm land has lapsed into unprofitable condition, fit only for timber growing.

These potential forest areas are classified into five classes, namely, abandoned farm lands, mismanaged farm woodlots, second-growth hardwood lands, watersheds, areas covered with bracken and sweet fern, burned-over coal and oil lands, scrub oak barrens. Each of these classes offers its own problems. Brief silvical notes, especially as regards adaptation to soils, on species recommended for planting are given.

The usual general discussion on light requirements, age and size of planting stock, time to plant, care of planting stock, soil preparation and spacing is based on the practice of the department. We learn that most of the planting is done with two-year-old seedlings (conifers); only under adverse conditions three-year-old stock is used; but for Norway spruce three-year-old stock is preferred on account of the very uneven size of two-year-old plants grown in the nursery. Fall planting has been found objectionable on account of frost-heaving; the season for spring planting starts in the southern parts of the State about the end of March, in the northern parts from one to three weeks later, according to latitude.

It is notable that any kind of elaborate soil preparation is discountenanced on account of the expense and the relatively small advantage, except where plowing can be done cheaply. Moreover, where existing growth is removed and burned, as on scrub oak barrens, coppice shoots are produced and interfere with the planted stock. The spacing usually employed and recommended "for Pennsylvania conditions" is 4 by 4 or 5 by 5, *i. e.*, 1,700 to 2,700 plants

per acre. That no distinction is made with different species and sites is, to say the least, an oversight. Mixed forest is recommended, but the principles for mixtures are not fully developed, or advisable mixtures mentioned.

Mattock or grubhoe seems the only planting tool employed. The advice, when planting in heavy sod, to remove only 4 by 7 or 8 inches of the sod for the plant hole does not seem to us sound for use with two-year-olds; the grass will soon choke the plants; even a foot square does often not protect the plant long enough against encroachment.

Altogether, over 16.5 million plants have been set out since 1899 under varying conditions at a total cost, including supervision, of $52,919, or $3.20 per thousand. In 1915 the cost was reduced to $2.95 on a planting of over 4 million trees, and in one case, where a small number were planted by boys and girls, to $1.28 per thousand. Taking the average price for the sixteen years, an acre plantation would come to $7 or $8. No mention is made of repair planting.

Several tables give measurements of height growth of various species from a number of plantations from year to year. A few hints are given regarding the prevention of damage to the young crop.

The law under which the surplus of stock in the State nurseries may be distributed free of cost, except shipping charges, is cited, and the addresses for applications given.

It appears that the State nurseries produce from 6 to 8 million plants and leave about 1.5 million for free distribution.

B. E. F.

Sugar Pine. By L. T. Larsen and T. D. Woodbury. Bulletin 426, U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1916. Pp. 40.

This bulletin is hardly up to the standard which the Forest Service should maintain, nor on a par with several other recent bulletins. It is of special interest to the lumberman, but of less value to the professional forester. The material has been presented according to the conventional Forest Service form, but logging and milling data have been given praiseworthy emphasis.

In discussing the moisture requirements and relative tolerance of

sugar pine and its associates, the authors have departed somewhat from the hitherto commonly accepted order. Sugar pine is listed as more exacting than Douglas fir as to moisture requirements and less exacting as to light requirement. Whether this divergence from the general opinion is due to the locality in which the observations were made cannot be determined from what is said in explanation.

The authors state (page 9): "The seed is disseminated principally by wind, which generally does not transport it over 150 yards, because of its large size and relatively small wings." Exact data as to how far the seed will carry so as to secure an adequate percentage of reproduction are not given.

Under the heading "The Wood," general notes supplemented by tables and photographs are given, showing appearance and structure, quality, weight, strength, shrinkage, hardness, durability and preservative treatment. This could have been greatly improved, however, if the subject had been treated a little more critically, pointing out the shortcomings as well as the advantages of the wood and comparing its properties with those of other similar woods.

Logging and milling methods and costs are treated in good style and great detail. Average cost per 1,000 board feet for logging is given as $5.30 and for milling as $3.70. The results of a mill scale study showing the percentages of the grades of lumber which can be cut from different grades of logs and from logs of different diameters, and also the percentage of overrun by log grades and qualities, are presented. Another subject well treated is the depreciation of sugar pine lumber during air seasoning, which presents the results of a Forest Service study made in 1914, with recommendations for decreasing the loss during air seasoning.

The authors have devoted a whole page to a detailed description of shake making, because of the local importance of this industry. Elsewhere in the West, however, this is fast becoming chiefly of historic interest because of waste involved.

The tables of growth (pages 25 to 28) are characterized by insufficient data as to locality and conditions under which the material was obtained. The authors have also followed the custom of showing maximum, average, and minimum growth for individual trees rather than growth by sites tied up with soil descriptions which would be of much more practical value. Table 17 (page 26) for diameter growth is poor in that it aims to show variation in growth caused by locality

rather than by site and density and then assumes that the growth shown may be used as an indication of the growth under different site and density conditions. A table showing differences in growth under different site and density conditions would be of far greater service than one showing differences in growth in different localities. The comparison is not of scientific value, because the marked differences in locality may be due to site or density.

An interesting point in regard to the culmination of the height and diameter growth is brought out in the following paragraph (page 27):

"It appears from the diameter-growth table that the maximum current diameter growth occurs between 80 and 100 years, which is also the period of maximum height growth. The maximum average annual growth for this 20-year period is 0.37 inch. The rate of growth in diameter decreases less rapidly, however, than the rate of height growth, the current annual exceeding the mean annual growth up to about the hundred and forty-fifth year. Usually the height growth of a tree species culminates before the diameter growth. Whether the sustained rate of height growth apparent in this species is attributable to the fact that the trees measured grew in virgin forest, where their light requirements were not satisfied during youth, or whether this is an inherent peculiarity, has not yet been fully determined, and cannot be until older, more normal second-growth stands are available for study."

Another striking feature of sugar pine is the great age to which it sustains its volume growth (page 27):

"The current annual volume growth remains above the mean annual growth for over 400 years, over 300 years after the height and diameter growth have culminated. At 100 years of age the annual rate of volume growth is 2 cubic feet. It then increases steadily up to an annual rate of 5½ cubic feet at 350 years. The rate of volume growth remains practically constant from that age up to 460 years. No information to indicate its behavior at a greater age has been collected."

Tables showing yield and increment on one quality of soil (II) for all species together are given for the two types in which sugar pine occurs (page 29). The method of constructing these tables is not explained, and no figures are given to show the approximate percentages of the different species in the mixture. From these tables the yield in the fir-sugar pine type apparently culminates at 340 to 350 years. This extreme age for culmination of yield is

rather surprising when compared with 220 years as given for culmination of yield in the sugar pine-yellow pine type.

The rotation on which to cut sugar pine-yellow pine stands is said to be determined by the highest rate of volume production, and is placed at 180 years. The yield table figures for this type show a mean annual growth at 180 years of only 122 board feet per acre, while at 220 years this has risen to 130.5 board feet per acre. Thus, unless some other consideration has entered into the problem, the rotation for highest rate of volume production would be 220 years rather than 180. There seems to be some mistake or oversight if all the data have been correctly presented.

On the basis of a rotation of 180 years it is shown that yellow pine can be cut to 30 inches and sugar pine to 33 inches, yet the cutting of both to 30 inches is recommended. Later on (page 32) it is said that knotty trees under 32 inches in diameter can only be marketed at a loss, so that it seems that a limit of 30 inches should be advised for yellow pine only and 33 inches kept for sugar pine. The condition of the tree, however, as determined by the condition of the crown, is the prime factor in guiding the cuttings. Maturity is indicated by flattened tops. From 12,000 to 18,000 feet per acre must be removed in order to make the operation profitable, and it is estimated that on this basis a second cut can be made in from 50 to 60 years.

The sugar pine stands are divided into two classes as a basis for cutting, one in which the forest is made up of mixed but approximately even-aged groups, and the other in which trees of all ages are intermingled singly. For the former class of stands a group selection, taking out from 65 to 75 per cent of the stand by volume, is advised. For the latter a system called single-tree selection, removing from 75 to 85 per cent of the stand (better termed a clear cutting, with scattered seed trees), is advised. With cuttings as heavy as these, reproduction of sugar pine is not expected immediately, except in the partial shade of the trees left, but after yellow pine, fir, and cedar have come in, it is expected that the sugar pine will get a start and ultimately occupy a dominant position in the stand because of its more rapid and sustained growth. There is some doubt if this result will take place, however.

Planting of cut-over lands to facilitate sugar pine reproduction is shown to be impracticable at present because of the poor germina-

tion percentage of the seed and unsatisfactory development of the seedlings and transplants in the nursery. All this goes to make the average cost of a plantation of 3-year-old trees $22 per acre, which is excessive. Sowing has always proved a failure.

In the appendix are given (1) volume tables, from which are lacking data on type, elevation and date at which measurements were taken; (2) merchantable length and d.i.b. of top log by diameter classes, given in a separate table; (3) a key for the microscopic identification of the woods of the important white pines, which really shows the great similarity in structure of the different woods and the real impossibility of distinguishing them except by a familiarity with their general external appearance, gained by constant handling of them; and (4) an excellent statement of the grades into which sugar pine lumber is cut, a feature which should be repeated in other tree studies.

C. E. B.

Lumber Markets of the Mediterranean Region and the Near East. By R. Zon. Miscellaneous Series, No. 51, Department of Commerce. Contribution from Bureau of Foreign and Domestic Commerce. Washington, D. C. 1917. Pp. 31.

This compilation was conceived as a contribution toward preparedness for post-bellum trade; it brings information regarding not only the exports and imports of the various countries bordering on the Mediterranean, but also, briefly, references to their forest conditions and trade customs.

It is open to question whether encouragement to increased wood export, as this publication plainly has in view, is a patriotic undertaking from the forester's point of view. We hold that, if an outlet for poor grades could be found, it would be a help toward making forestry practice possible; but this oceanwise export, we fear, can only increase the utilization of our best grades. It is quite clear that with a $10 and $12 freight rate from United States ports to Mediterranean ports, as against $3.35 to $5 rates from competing countries, the United States exports can be only of superior values; indeed, they consist chiefly of longleaf pine and oak cooperage materials.

The question arises whether altogether from a patriotic point of view the export of raw materials or, indeed, of any wood materials is to be encouraged. Have we not reached that point, with our limited

timber supplies, when conservation of resources for home consumption is the true, statesmanlike attitude? We know that the lumber industry is suffering from overproduction and seeking increased markets, but other remedies than increased exploitation of the best grades can surely be found to cure the industry.

The material is handled in the clear and comprehensive manner to which we are accustomed from the hands of Mr. Zon. We would, however, suggest that by mixing Persia and France with the Mediterranean countries the picture becomes unclear. With Persia, which stands for the "Near East," we have so far nothing doing, and there is not any likelihood of trade in that direction. France does, to be sure, border on the Mediterranean, but as far as we can see in the import statistics the part of our export to France that comes to Mediterranean ports has not been segregated, and hence the picture is clouded. And since out of the total of 10 or 12 million dollars' worth of imports about 50 per cent go to France, the cloud is considerable.

In comparing the contribution of imports from various countries, the same irrelevancy appears, when Finland, Russia, and Sweden are cited, for the bulk of their exports to France, with some 25 million dollars, surely goes to other than Mediterranean ports.

So far, Roumania and Austria-Hungary furnish the bulk of imports to Mediterranean ports, due, according to the author, not only to physical advantages, but to greater initiative on the part of lumbermen of these States as compared with Russia, where also lack of capital to develop the Caucasian forest area, high cost of logging in the mountains, lack of efficient mills, and generally primitive conditions are charged as causes for lack of trade.

What the future will bring us is, of course, now more than ever a sealed book.

Italy, which takes the lion's share of the truly Mediterranean imports, with about 24 million dollars' worth out of 45 million, will probably feel the difficulty of supplying herself after the war most seriously.

Incidentally, the reduction of imports in 1915 below those of antebellum years is striking. Italy's imports fell from 25 million in 1913 to 4.7 million in 1915. France, which in 1913 had increased her wood imports to nearly 58 million dollars, had in 1915 only little over 18 million dollars import, while the export had been reduced to one-half.

B. E. F.

Economic Desirability of Tree Planting in Grasslands. By N. Spiridonov. Agricultural Gazette. No. 12 (128). Petrograd. March, 1916. Pp. 310-311.

Observations were carried on in Russia for a period of 25 years on about 110 acres on the effect of trees upon the grass cover within a wooded region. The tract was divided into 18 meadows, part of which was free from trees; the remainder was sown to grass and the trees retained as far as possible.

During two or three periods of great drought the value of the treeless grasslands fell off 12 to 50 per cent, while that of the grasslands planted with trees increased 16 per cent. In rainy years the latter exhibit much better vegetation than that of grassland without trees.

At first the treeless grasslands were the best as regards vegetation; about 12 years afterward, however, the composition and appearance of the vegetation suddenly grew worse, and at the present time (25 to 30 years after) these grasslands have the aspect of moorland covered with *Nardus stricta* L. Hillage, manuring, and sowing with good forage crops failed to produce a permanent improvement in these grasslands. The turf layer was broken up and the grasslands were plowed, after which various crops were sown, but the result was always the same. In the first year the grassland produced 35.8 cwt. of hay per acre, containing 80 per cent of leguminous plants; in the second year it produced about 17.9 cwt. of hay, in which gramineae predominated; in the third and fourth years the crop became poor; it afterward fell off rapidly to such an extent as to be below that of the uncultivated grasslands.

In the grasslands planted with deciduous trees (birches) the vegetation begins to improve toward the twelfth year after they have begun to be harvested, and attains its maximum development between the sixteenth and twentieth years. Then, when the tops of trees and the roots close, there is a rapid retrogression; vegetation becomes sparser, the leguminous plants disappear, and the crop suddenly declines. If, however, during this period the trees are cut, there is for three or four years a fine hay crop, rich in *Lathyrus pratensis, Trifolium montanum,* and in *T. incarnatum.* Such cutting, however, is not desirable. It is better to be satisfied with poor crops for six or eight years (the crops, however, never fall below

those yielded by *Nardus stricta* on the treeless grasslands), and then cut down the trees. After 28 years, each birch yields 2.8 cubic meters of wood, aside from branches. In short, these observations hold out the promise of obtaining 400 cubic meters of wood in 28 years and at the same time good hay crops.

These results were obtained on grasslands which were very irregularly planted with birch trees, the roots of which spread out near the surface of the soil and deprived it of moisture. The falling off in the hay crop is probably due to shortage of water when the roots of the trees interlaced in the twentieth year. If, however, instead of birches the grassland is planted with deep-rooted alders, no such effect was observed. Around the alders the vegetation was of better appearance than around the birches, and came up close to the tree trunks without any reduction in height or change in color, while around the birches the vegetation was weaker and discolored. Although the upkeep of high forest alders, as compared with that demanded by birch trees, is greater, the economic advantages of planting grasslands with alder were brought out clearly. With 220 alders per acre, a good hay crop may be maintained without manuring and without any hindrance to the growth of the grass and the use of the reaper. The trees may be replaced every 14 or 15 years without injuring the grassland by planting young trees 5 or 6 years old in the clear spaces 7 years before felling the old ones.

Anticipating the objection of insufficiency of sunlight on a piece of grassland planted with trees, it is stated that in a wet climate the cutting off of the light by the trees may be a serious drawback, but in a dry climate, where excessive sunshine results rather in burning the grass than promoting the formation of chlorophyll, the planting of trees, as has been shown, proves beneficial.

The importance of the potassic and phosphatic substances returned to the soil by the large quantities of dead leaves of a 17 to 22 year old forest should also not be overlooked.

RECENT PUBLICATIONS

Poles Purchased in 1915. By A. M. McCreight. Bulletin No. 519. U. S. Department of Agriculture. Washington. January 24, 1917. Pp. 4.

The report shows that over 4 million poles were purchased in 1915, a quantity greater by 16 per cent than in 1911. The pole supply comes largely from three regions—the northern white-cedar region of the Lake States, the chestnut region in the eastern part of the United States, and the western red-cedar region of the northwest. About 67 per cent of the poles were under 30 feet in length and 30 per cent from 30 to 35 feet in length. Much progress is reported in the butt treatment of cedar poles by the open-tank method, a considerable proportion of the cedar poles sold being so treated.

Tenth Annual Report of the Commission of Forestry. Made to the General Assembly at the January session, 1916. State of Rhode Island. Providence. 1916. Pp. 18.

Contains a summary of forest fires occurring during the year, a list of landowners who have forest plantations, a list of persons who have engaged in thinnings and reproduction cuttings, and recommendations for future work.

Fur Farming as a Side Line. By Ned Dearburn. Separate No. 693, from U. S. Department of Agriculture Yearbook. 1916. Pp 18. Illus.

Vermont Timberland Owners' Association. Second Annual Report. Bloomfield, 1916. Pp. 6.

The association reports an exceedingly favorable year, having had only four fires, with a total burned area of 4 acres, as compared to 18 fires in 1915, which burned over 2,301 acres. The association had thirteen patrolmen and two watch-tower men. The expense is met by a ¾ cent per acre assessment.

Shade Trees. Hardy Shrubs, Roses, Perennials, and Other Ornamental Plants Recommended for Maine. Bulletin of Department of Agriculture. Maine. Vol. XV, No. 3. Augusta, Sept., 1916. Pp. 33. Illus.

Michigan's Shifting Sands, Their Control and Better Utilization. By F. H. Sanford. Special Bulletin No. 79. Michigan Agricultural College, Experiment Station. East Lansing. May, 1916. Pp. 31. Illus.

Proceedings of the Southern Forestry Congress. A standard book on southern forestry practice. Copies may be secured at $1 each from J. S. Holmes, Secretary, Southern Forestry Congress, Chapel Hill, N. C.

Biennial Report of the State Conservation Commission of Wisconsin for the Years 1915 and 1916. Madison. 1916. Pp. 160. Illus.

That portion dealing with the Division of Forestry and Parks reviews briefly the history of the land-buying policy of the State and the State Supreme Court decision in regard to it; also fire protection, State parks, etc.

Fourth Biennial Report of the State Forester, 1915-1916. State of Montana. Pp. 55. Illus. 1 map.

The report covers the scope and objects of State forestry in Montana, farm and city trees, timber resources of Montana, qualities and uses of the more important Montana woods, the preservation of wood, fire protection in Montana, recreation in the mountain forests of Montana, recommendations for improvement in existing laws.

The Early European History and the Botanical Name of the Tree of Heaven. Ailanthus altissima. By W. T. Swingle. Journal of the Washington (D. C.) Academy of Sciences. Vol. VI, No. 14. August 19, 1916. Pp. 490-498.

Northern Nut Growers' Association. Report of the Proceedings at the Seventh Annual Meeting. Washington, D. C. September 8 and 9, 1916. Pp. 118.

The proceedings contain the following articles of special interest: The Chestnut Bark Disease, by Dr. Haven Metcalf; Discussion and Resolutions on Quarantine for Chestnut Nursery Stock; Hybrids and Other New Chestnuts for Blight Districts, by Dr. Walter van Fleet.

Report on the Lands and Mines Department (British Guiana) for the Nine Months, April to December, 1915. Georgetown, Demerara. 1916. Pp. 21.

The Industrial and Social Importance of Forestry in China. By Forsythe Sherfesee. Reprinted from Vol. 1, No. 3, The Chinese Social and Political Science Review. Peking. October, 1916. Pp. 26.

Annual Progress Report Upon State Forest Administration in South Australia for the Year 1915-16. By Walter Gill. Adelaide. October 18, 1916. Pp. 13. Illus.

PERIODICAL LITERATURE

Owing to the irregularity and slimness of forest literature, due to the war, this department must necessarily be meagre for the present.

Douglas Fir in Denmark

The planting of Douglas fir in Denmark was begun about 1880; since then this species has been planted quite extensively. During the years 1907 to 1909 several sample plots were laid out in order to obtain more definite growth data. Three of such sample plots form the basis for the following discussion and comparison by Opperman. The plots used as a basis for the figures are rather small, 1/6 to 1/4 of an acre, and of three different degrees of stocking and thinning, the age varying from 25 to 30 years, dating from the year of germination. The seed used in the Danish plantings under discussion here came from the coast of California.

Plot No. 1, located in a narrow belt of conifers, quite level and quite rocky, the soil being a mixture of coarse sand and clay with a good layer of humus, having been thinned when 18, 20, and 22 years old, showed the following conditions before and after the fourth and fifth thinning:

TABLE FOR PLOT NO. 1

	Before Thinning	*After Thinning*	*Before Thinning*	*After Thinning*
	26 *Years*		29 *Years*	
Number trees per acre	844	618	618	457
Basal area, sq. ft. per acre	187.2	150.5	183.9	148.3
Average diameter, inches	6.4	6.7	7.4	7.7
Average height, feet	50.5	51.0	57.4	58.1
Volume, cu. ft. per acre	4,883.4	3,958.3	5,389.3	4,391.8

The plantation had been made in the spring of 1885 under an open stand of mature beech. The spacing used was about 3 by 4 feet. About 700 Douglas fir seedlings were planted on an area of about 1/3 of an acre. The sample plot, however, includes only a little over 1/4 of an acre, in order that the plot would be entirely surrounded by Douglas firs. The mature stand of beech was removed after a year or two because the Douglas fir could not endure such a dense shade.

In the first thinning, when the stand was 18 years old, a volume of 563 cubic feet was removed. The next thinning, two years later, removed 674 cubic feet per acre. The third thinning, again after an interval of two years, removed a yield of 413 cubic feet per acre.

The next thinnings were made four and seven years later, with the above results.

The total yield, then, on the basis of the plot, at 29 years of age, is 7,964.3 cubic feet per acre, of which 2,575 cubic feet consists of thinnings. The intermediate yield at this early age was thus 32.5 per cent of the total yield. The mean annual growth was, altogether, 274 cubic feet per acre, while the current annual growth for the three-year period is 477 cubic feet per acre. The culmination of either yield has probably not been reached as yet. It is interesting to note that, in the thinning at 26 years of age, the removal of 26.7 per cent of the number of trees removed 18.9 per cent of the volume. The removal of these trees increased the average diameter .3 of an inch and the average height .5 of a foot. The thinning made three years later removed 26 per cent of the number of trees and 18.6 per cent of the volume. In this case the thinning raised the average diameter .3 of an inch and the average height .7 of a foot. In the three years after the fourth thinning the basal area increased over 22 per cent and the volume 36 per cent.

It is interesting to note the uniformity of the stand, as shown by these figures, for the two thinnings. This intensive system of thinnings is very typical of Danish methods and is of wide interest because of its intensiveness.

Plot No. 2 was located in northeastern Sjaelland, with continental climate. The plantation in which the plot is located is surrounded by young stands of fir (Abies) and beech. The plot, consisting of a little more than ¼ acre, has a slight southwest exposure. The soil is a moderately coarse sand, which gradually grades into a fine sand sub-soil, with a considerable layer of humus; the site being classed as slightly inferior to that of Plot No. 1.

The plantation was made in the year 1885. It consisted of 1,500 Douglas fir seedlings spaced about 4 by 2½ feet. In the year 1890, there was an attack by the root fungus *Polyporus radiciperda* which caused quite a loss. The resulting fail places were filled with larch and spruce, but practically all these were killed through suppression.

The first thinning was made when the stand was about 26 years old, when about 1,200 trees per acre were removed, with a volume of about 1,271 cubic feet. This thinning, however, was more of an improvement cutting than a thinning. The first real thinnings gave the following data:

TABLE FOR PLOT NO. 2

	Before Thinning 27 Years	*After Thinning* 27 Years	*Before Thinning* 30 Years	*After Thinning* 30 Years
Number trees per acre	1,369	1,066	1,066	660
Basal area, sq. ft. per acre	141.1	119.9	145.6	104
Average diameter, inches	4.3	4.5	5.0	5.4
Average height, feet	36.6	36.7	43.2	44.7
Volume, cu. ft. per acre	2,852.6	2,426.8	2,954.1	2,165.3

The mean annual growth after the first thinning was 155 cubic feet per acre as against 105 cubic feet before the thinning, and the current annual 175.4 cubic feet per acre. The current annual growth will undoubtedly increase rapidly as soon as the effect of the thinnings is felt. The thinning at 27 years of age removed 22.1 per cent of the trees and 14.9 per cent of the volume; it increased the average diameter by .2 of an inch and the average height by .1 of a foot. The thinning at 30 years of age removed 38 per cent of the number of trees and 26.7 per cent of the volume; the average diameter was increased by .4 of an inch and the average height by 1.5 of a foot. The basal area and the volume after the thinning increased in the three years 21 per cent.

The variation in size, as shown by the thinnings, is doubtless caused by the lack of early thinnings. The smaller yield in this plot than in Plot No. 1 is probably caused by the same factor, namely, by heavier stocking and poorer site. The difference in quality of site is, however, very small.

Sample Plot No. 3, surrounded by an older forest and hence somewhat protected, has a clayey loam soil inclined to be somewhat rocky. The humus conditions are good. The author places the quality of the site as midway between that of 1 and 2. This plantation was made in the year 1887, spacing 3 by 4 feet.

The first thinning was made when the stand was 21 years old. No record was kept of the volume removed. The subsequent two thinnings are recorded in the table.

TABLE FOR PLOT NO. 3

	Before Thinning 25 Years	*After Thinning* 25 Years	*Before Thinning* 28 Years	*After Thinning* 28 Years
Number trees per acre	1,556	1,028	1,028	773
Basal area, sq. ft. per acre	181.1	142.1	167.5	136.8
Average diameter, inches	4.6	5.0	5.5	5.7
Average height, feet	39.6	39.9	46	46.3
Volume, cu. ft. per acre	3,895.7	3,067.3	4,186	3,535.8

The mean annual growth of this plot was 156 feet at 25 years, and had in three years increased to 178 cubic feet per acre, and the current annual growth to 372.9 cubic feet per acre. Thus the culmination of the growth has not as yet been attained. The thinning made when the plot was 25 years old removed 33.9 per cent of the total number of trees, but only 21.2 per cent of the volume; the average diameter was increased .4 of an inch and the average height .3 of a foot. The thinning made three years later removed 24.8 per cent of the number of trees and 15.5 per cent of the volume; the average diameter was increased .2 of an inch and the height .3 of a foot through the thinning. The volume had in the three years increased by 36 per cent.

The three plots, being on about the same quality of site are therefore quite comparable in several respects. The effect of early and frequent thinning on volume growth is clearly shown by the figures for Plot No. 1 when compared with Nos. 2 and 3. The figures show that, with early and frequent thinnings, the amount to be removed becomes more nearly a constant per cent of the number of trees and of the volume. The stand, too, becomes more regular, as is shown by the slight increase in the average size of the trees in Plot No. 1 after the thinning. Plot No. 1 has a mean annual growth nearly twice that of Nos. 2 and 3. Neither site nor degree of stocking would account for such a difference. Originally, Plot No. 1 must have contained 2,100 trees per acre at least.

Mr. T. S. Hansen, to whom we are indebted for this brief, adds a comparison with figures on the growth of Douglas fir in this country. The best comparison can probably be made with that given in a yield table by T. T. Munger, in U. S. Forest Service Circular 175, for a 30-year-old stand on quality I soil.

COMPARISON OF PLOTS AND YIELD TABLE

Plot	*Age Years*	*Number Trees*	*Total Basal Area, Sq. Ft.*	*Average Diameter Inches*	*Average Height Feet*	*Volume Cu. Ft.*	*Current Growth*	*Mean Annual Growth*
				Per Acre				
Yield Table	30	580	149	6.9	46	3,550	140	118
1	29	618	183.9	7.4	57.4	5,389.3	477	185.8*
2	30	1,066	145.6	5.0	43.2	2,954.1	175.4	98.5*
3	28	1,028	167.5	5.5	46	4,186	372.9	149.4*

* Without inclusion of thinnings.

From the above comparison, we can see that the intensively thinned Plot No. 1 has a much better development than that shown in the yield table for a stand of approximately the same age. Plot No. 1 has thirty-eight more trees to the acre than the yield table with a basal area 34.9 square feet larger. The average diameter is .5 of an inch larger and the average height 11.4 feet greater for trees on the plot. The yield, too, shows Plot No. 1 to be much better, being 1,839.3 cubic feet greater for the plot. This excess is exclusive of all thinnings.

The other plots less frequently thinned are poorer than the yield table in some respects and better in others. In the matter of both current and mean annual growth the plots all excel the yield table.

The figures all point to the advisability of thinning early and often, in accordance with textbook instruction. This should hold for this country, where the tree is native, as well as in Europe. The figures serve as an indication of what can be done in this country when economic conditions permit.

Den Grönne Douglasies vaekst i Danmark. Det Forstlige Forsögsvaesen i Danmark, 1912. Vol. 4, No. 1.

Logging and Sawmill Safety Orders

The State of California has drawn up a set of logging and sawmill safety orders which go into effect March 15, 1917.

The orders covering logging work have already been issued and contain provisions for the inspection of donkey boilers and engines, a uniform set of donkey engine signals, specifications in regard to management of lines and blocks, location of log landing with reference to loading railroad donkeys, and standard specifications for logging railroad track and logging car equipment.

The rules as laid down should reduce the hazard of personal injury on logging works, which has been greater than in some other industries.

West Coast Lumberman, Feb. 15, 1917.

Hardwood Manufacturers' Competition

At the annual meeting of the Hardwood Manufacturers' Association of the United States, which opened January 30, 1917, there was adopted a plan for open competition among hardwood manufacturers. This plan is rather unique in association activities, but its ultimate aim, however, is similar to plans used in other associations which have attempted to provide their members with trade information.

"The purpose of the plan is to disseminate among members accurate knowledge of production and market conditions so that each member may gauge the market intelligently instead of guessing at it; to make competition open and aboveboard instead of secret and concealed; to substitute in estimating market conditions, frank and full statements of our competitors for the frequently misleading and colored statements of the buyer."

The plan covers all hardwoods, but it is to be applied only to oak at the outset and as members become familiar with the method it will be applied to all other hardwoods. The plan calls for reports on the following from each member: Production, sales, shipments, stock on hand, price lists, inspection.

The scheme as outlined deals with past prices and performances and does not aim at fixing in any way future hardwood lumber prices. The success of the venture will depend on the attitude the various members assume toward furnishing the data provided for in this plan.

Hardwood Record, Feb. 10, 1917.

Price Relation of Coal and Mine Timber

The difficulty of securing mine timber in Great Britain and the rise in wood prices has created the belief that the latter had a prominet influence on coal prices. Coal, which in September, 1914, cost $5 per ton, by June, 1916, had risen 50 per cent, to $7.50. A simple calculation shows that the rise in wood prices is responsible for only a little over 4 per cent. It is stated that in the average 6 to 8 linear feet of all classes of mine timber are needed to mine one ton of coal, hence an increase of 25 cents per 100 linear feet is equal to an increase of 1.7 cents per ton of coal. The calculation of the influence is made as follows, under the assumption that only short mine props are used:

Sizes	2	2½	3	3½	4	4½ inch top
Proportion used	3	15	45	20	12	5 per cent
Increase in price per 100 feet	50	58	71	89	114	95 per cent
Relative increase in price per ton of coal	3	5	7	10	15.2	16.8 cents

Averaging the last row of figures gives the increase in price of coal due to increased wood price as 9.5 cents.

Transactions Royal Scottish Arboricultural Society, January, 1917, pp. 70–71.

Baden Statistics

As in peace time, the government of Baden has published in 1916 the statistics for the year 1914, giving an insight into conditions just before the war.

Since 1878, remarkable to tell, the forest area has increased 11.8 per cent, to 1,354,145 acres. Of this, 17.2 per cent is state property, 44 per cent municipal, and 38.8 per cent private and corporation property. Of the 247,000 acres of state property, nearly 9,000 acres are in farms. The wood product per acre was 95 cubic feet (as against 61 cubic feet in 1878), of which nearly 30 per cent came from thinnings. The workwood per cent (our log material) had increased to 50 per cent, as against 30 per cent in 1878. Nearly 65 per cent is coniferous material. The gross sale value of the harvest (cut in the woods) was \$1,750,000, or somewhat over 7 cents per cubic foot. An income from by-products of some \$64,000 is recorded, of which nearly half for litter for bedding.

During the period from 1881 to 1914, the per acre income for wood has grown 132 per cent; namely, from \$3.94 to \$9.12, one-third of which increase is due to increased utilization and two-thirds to price increment. At the same time costs have increased to nearly 40 per cent of receipts, nevertheless, the net result per acre has increased from \$2.35 to \$5.52, or 135 per cent, or 3.75 per cent per annum. The expenditures were distributed on administration 24.3 per cent, on improvements 20.3 per cent, and 55.4 per cent on operation.

These data refer to the state forests. The municipal forests, being mostly under state management, show only slightly lower returns, the gross wood income of all amounting to around 4.6 million dollars.

It is interesting to note that less than 1 per cent of the total forest area was artificially reforested and that nearly 12 per cent of the 2,000

acres involved were reforested by direct seeding. For roads, an expenditure of around 50 cents per acre is recorded.

Damage by insects, fungi and fire was negligible, but snow, ice and wind breakage affected some 2,000,000 cubic feet of wood.

Statistische Nachweisungen aus der Forstverwaltung des Grossherzogtums Baden für das Jahr, 1914. Schweizerische Zeitschrift für Forstwesen, January, 1917, pp. 29–31.

Russian Exports

On August 7, 1916, there was held the Second All-Russian Congress of Representatives of the Lumber Industry, the council of which has issued a report advocating the greater development of the Russian export trade in forest products after the conclusion of the European war.

The steps suggested as necessary to carry out this scheme comprise the organization of the Russian timber exporters, in order to regulate the manufacture of lumber and to maintain prices in the foreign markets; complete manufacture of exported goods, before export; an accurate survey of Russian timber resources; development of rail transport in the forest regions; cutting of greater quantities of timber from state forests, and the abolition of various limitations imposed by the existing corporation laws, in order to make more attractive the investment of capital in the lumber industry.

The report points out that previous to the war three-fifths of Russian woods exported were in the form of logs, the manufacture of which was carried out abroad, chiefly in Germany.

Russia looks to Italy as one of her most important future customers. It has been estimated that the annual demands of Italy after the war will be about 7,000,000 cubic feet for sleepers, and 700,000 cubic feet for telegraph poles alone. The general annual requirements of foreign wood in Italy are about 71,000,000 cubic feet.

Greece is also looked upon as a great future market for Russian woods.

The early development of the Russian walnut trade is predicted, since there is an "unlimited" amount in the Caucasus and Transcaucasia.

Russia. Vol. I, No. 7. Nov., 1916, pp. 30–32.

Forests of Serbia

According to H. H. Dietrich, owing to the ruggedness of the country, and hence difficulty of constructing means of transportation, Serbia still abounds in forest wealth. Only two rivers, the very shallow Morava and the Drina, which forms the boundary toward Austria, connect with the Danube. But these waterways are of little avail because they lead away from central European markets to Bulgaria, Roumania, southern Russia, which have their own extensive supplies; hence there has not been great activity in exploiting the forests except for home use, and even these small requirements are sometimes difficult to satisfy on account of the difficult logging. What capital is employed in opening resources in recent years came from France, several banks being interested in logging operations. The government imposes stumpage dues for cutting timber without any conservative ideas or regulations.

Chutes, supplied by sled roads and sometimes by horse trucks on wooden tracks, are the customary method of running logs to the rivers and they are then rafted down the stream. Lately an overhead cable system has been employed. One of these has a drop of nearly 4,000 feet in six miles, with stations along the line, transporting crews to and from the operation, as well as logs.

The forest is mostly mixed with beech as principal species; conifers, pine and fir (or spruce?) in pure stands occur only in the higher elevations, much of it fire-scarred by the fires of shepherds.

The Timberman, June, 1916, pp. 33–34.

SOCIETY AFFAIRS

Through oversight, notice of the result of the annual election of officers for 1917 was not published in the January issue of the Journal. Officers were elected as follows: President, F. Roth; vice-president, W. T. Cox; secretary, R. Y. Stuart; treasurer, C. R. Tillotson. Executive council: W. B. Greeley, 5-year term; H. S. Graves, 4-year term; R. C. Bryant, 3-year term; D. T. Mason, 2-year term; Clyde Leavitt, 1-year term.

The following were elected officers of the Portland (Oregon) Section of the Society of American Foresters for the current year at the annual business meeting, held at the Beck Building, Portland, January 23: Julius F. Kummel, chairman; A. G. Jackson, secretary-treasurer: E. O. Siecke, member executive committee.

Forest Supervisor W. G. Weigle, of Ketchikan, Alaska, addressed an open meeting of the Portland (Oregon) Section of the Society February 15. His topic was "Problems in National Forest Administration in Alaska." Thirty-four were present.

CONTENTS

Vol. XV APRIL, 1917 No. 4

JOURNAL OF FORESTRY

OFFICIAL ORGAN OF THE SOCIETY
OF AMERICAN FORESTERS

COMBINING THE PROCEEDINGS OF THE SOCIETY AND THE FORESTRY QUARTERLY

PUBLISHED BY THE
SOCIETY OF AMERICAN FORESTERS
At 930 F STREET N. W.
Washington, D. C.

Single Copies, 50 Cents Annual Subscription, $3.00

Entered as second-class matter at the postoffice at Washington, D. C., under the act of March 3, 1879

JOURNAL OF FORESTRY

A professional journal devoted to all branches of forestry

EDITED BY THE EDITORIAL BOARD OF
THE SOCIETY OF AMERICAN FORESTERS

The Journal appears eight times a year—monthly with the exception of June, July, August and September.

The pages of the Journal are open to members and non-members of the Society.

Manuscripts intended for publication should be sent to Prof. B. E. Fernow, at the University of Toronto, Toronto, Canada, or to any member of the Editorial Board.

Subscriptions and other business matters may be addressed to the Journal of Forestry, Atlantic Building, 930 F Street N. W., Washington, D. C.

JOURNAL OF FORESTRY

VOL. XV | APRIL, 1917 | No. 4

THE PRESENT CONDITIONS IN THE LUMBER INDUSTRY[1]

BY WILSON COMPTON

Federal Trade Commission

I am grateful for this opportunity cordially extended to me to speak to you upon a subject in which I have a deep interest, and upon which I beg to say I have spent considerable thought during the past several years. I desire neither to harass you nor embarrass myself by reading a lengthy paper at this time. At best one can touch only the prominent features. And in the suggestion of a remedy for an unfortunate industrial situation one can only join hands with the lumbermen in groping for a solution that is consistent with the interest of the public.

At the outset I desire to relieve the discussion of the consideration of exceptional and non-typical cases and to confine attention to the general conditions which are representative of the average lumbering operation. One may at any time with ease cite specific cases that are at variance with the general characterization of the industry. Out of more than 40,000 mills of all descriptions and more than 35,000 retailing establishments, innumerable exceptions can be cited. But these tend only to emphasize the facts attributable to the majority. The security and the reasonably conservative use of a basic natural resource is dependent upon the general rather than upon the exceptional conditions. And no solution is adequate which fails to provide for reasonably conservative utilization of standing timber. Emphatically, the present condition in the lumber industry is inconsistent with conservation.

[1] Read before the Society, January 25, 1916.

The Reserves of Standing Timber

To define the general situation in the lumber industry in one sentence, I should say that the trouble with the lumber manufacturer today is that he is a timber owner. To one familiar with the tradition of the industry that all the profit comes from the ownership of standing timber and "the more timber the more profit," this statement may sound like heresy; and thus it appears to many lumbermen. But I will go yet farther and will venture the assertion that a part of the timber standing in the Pacific Northwest—the most inaccessible of it, to be sure—some of which seven or eight years ago was bought and sold at as much as $1.50 per thousand feet in actual cash outlay, is, in view of the probable future price to be realized for it and in view of the lapse of time before it can profitably be cut, not worth today more than 20 cents a thousand feet, if indeed that much. There stands today, in the Pacific Northwest, more than half of the remaining merchantable timber in the whole of the United States, or about 1,500 billion feet. At the present rate of cutting it constitutes approximaely 165 years' supply. If the rate of cuting shall double within ten years or be quadrupled within twenty years there will nevertheless be some timber that cannot be cut for more than fifty years to come.

As business calculations are made in the industry today if timber owners knew with certainty that for underlying economic reasons it would be impossible profitably to cut certain timber for, say, fifty years and that not more than $6 or $7 could even then be realized for it, I doubt much that some owners would refuse a price of as little, perhaps, as 10 cents today.

The Change in Conditions of Timber Holdings

Such certainty does not, to be sure, exist in the lumber industry today. The enterprise of holding timber over long periods of time is essentially speculative. The returns are uncertain and the years of waiting before the returns are realized is equally indefinite. But the fundamental facts with respect to the use of lumber are not encouraging to the investor in great reserves of standing timber. For example, with the filling up of the "silent places" in the western prairies, the per capita consumption of lumber has declined greatly. Likewise throughout the United States the per capita use of lumber has fallen from a maximum of 527 feet in 1906 to 375 feet ten years later, in 1915. During the same period the total production declined from 46

billion feet to approximately 40 billion. General industrial conditions, largely beyond the control of the lumberman, determine the demand for lumber. Because of its bulk and weight the export business is limited, and as yet has played but a relatively small part in the total distribution of lumber. Substitute commodities since 1900 have displaced the equivalent of nearly 8 billion feet of lumber annually and the amount of such displacement appears to be increasing. The prospect of a substantial net increase in the amount of timber that can be profitably sold is a doubtful one.

Under these conditions, which promise a long postponement of the income from timber holdings, the amount of the reserve supply of standing timber in private ownership is indicative of the unwisdom of many of the timber investments. In the Douglas fir region of western Washington and Oregon there is in private holdings the equivalent of 108 years' supply, or of 165 years' supply including the publicly owned forests. In the Inland Empire region, eastern Washington and Oregon, Idaho and western Montana, there is a privately owned supply, at the present rate of cutting, for 91 years; in California for 152 years; in the southern pine region for 24 years. More than one-third of the total timber in the West is owned by the Government. The addition of this would, of course, increase proportionately the reserve timber supply. These figures moreover take no account of regrowth, which is estimated by the Forest Service at approximately 40 per cent of the present average cut. The cutting of much of the virgin timber will probably be still further postponed because of the increasing competition met from lumber cut from second-growth timber. For instance, New England now produces more white pine lumber than does the State of Michigan, famous for its great pineries. In view of the increase in the prospective period of waiting involved, it is probable that much of the timber, especially in the Pacific Northwest, has been overcapitalized.

Commercial Capitalization of Timber

The so-called "commercial valuation" of all the privately owned timber in these five States of Washington, Oregon, California, Idaho, and Montana is approximately $1,200,000,000, or more than $1 for each 1,000 feet. Moreover, much of the capital invested in standing timber has been borrowed on timber bonds, bearing from 6 to 8 per cent interest. Likewise the taxes and the forest protection and ad-

ministration costs add heavily to the current carrying charges. If the total carrying charges on timber in each region were paid out of the receipts from current sales of lumber the annual charge on each 1,000 feet cut would be approximately $1.85 in the Douglas fir region, where the timber itself is valued at about $1.35; in California, $2.50, where the timber is valued at about $2.10; $2.40 in the Inland Empire, where the timber is now valued at approximately $1.90; and $1.17 in the southern pine region, where the timber is valued at from $4.50 to $5 a thousand feet. Of these timber-carrying costs more than one-half on the average is in the interest due on the timber bonds. Most of the remainder is in taxes. Both are compulsory payments and have become, in many instances, extremely burdensome and promotive of constant overproduction because of the insistent desire to liquidate a relatively unprofitable investment.

It is obvious that private timber has been, in many instances, grossly overcapitalized and especially that private owners have assumed a stupendous task in attempting to carry the equivalent, on the average for all regions, of more than 50 years' supply at the prices which they have paid for it. The loosely constructed, ill-conceived, and worse-enforced general land laws, as well as special legislative favoritism in the early days, are at the root of the existing situation. But private chicanery, promiscuous land grabbing, and fraudulent entry upon the public lands have been contributory causes for which private land greed is responsible and for which no legal or moral justification lies. But however this may be, there is a just doubt as to whether after all some of the private purchasers 40 or 50 years ago at $1.25 and $2.50 an acre were not, in fact, overcharged by the Government. The system of public land alienation was wrong in principle and its administration far from effective in securing the more equitable distribution of land which Congress desired.

The Valuation of Standing Timber

Turning for a moment to the South, we find that timber is capitalized at from $2.50 per thousand feet in the North Carolina pine region for relatively inferior stumpage to $6 in western Louisiana. The lumber manufacturers during the past seven or eight years, however, have found manufacture unprofitable—at least so they themselves have thought. The books of many operators do, in fact, show an

almost constant loss on operation. Yet these same mills have increased the book charge for their stumpage despite the fact that the milling operation continues to show a net loss. This practice is an economic curiosity. Suppose, for example, that the average price of lumber at the mill is $14 per thousand feet; that the total labor expended in its manufacture cost, including all salaries, $8; the mechanical equipment, machinery, steel ropes and saws, say, $2; wear and tear on the plant, $1; interest on the operating investment, $1; making a total cost as thus computed of $12 per thousand feet, and leaving, therefore, only $2 to be paid for the stumpage. Suppose, again, that this price continued at $14 per thousand feet over a long period of time and the costs likewise as enumerated, would it be correct at the end of ten years to say that the stumpage is worth $4 because "the value of timber should double every ten years," and, therefore, charge it to manufacture at that figure? I believe that that is essentially what many southern pine operators are doing today, and what they have been doing in substance since the time of the general fall in lumber prices in 1907 and 1908. What this method of stumpage valuation and accounting has resulted in is this:

First. Substantially stealing the capital assets of the stockholders by failing to charge depreciation enough to retire the investment and treating as a net return what are really only liquidating assets.

Second. Stealing from the operating profit account in order to pad the stumpage profits. Where the owner of the timber and the manufacturer are the same person or corporation, as is usually the case in the South, this fact has generally escaped notice. The stockholder, as a rule, knows but little and cares less whether his return comes from stumpage ownership or from operation. This practice is important, also, since the maintenance of a stumpage capitalization that is not earned is a vigorous invitation to the relative overassessment of timber for purposes of taxation.

Bonding of Timber

In the third place, I desire to call your attention to the more patent effects of the bonding of standing timber on a large scale, to which reference has been made. This practice was initiated in the South about the year 1900, and became generally prevalent as an aid to timber speculation in the West about 1905 or 1906. These timber bonds were regularly 10-year or 15-year serial bonds, paying from 6 to 8

per cent net interest, and stipulating that a certain amount of the timber thus bonded be cut each year in order to meet the payments of interest and principal as they accrued. The net result has been the issue of timber bonds amounting in 1914 and 1915 to approximately $65,000,000 in the Pacific Northwest, $26,000,000 in California, $18,000,000 in the Inland Empire, and $180,000,000 in the southern pine region. These bonds are secured chiefly by the timber, but in part by the mill plants themselves. The annual interest bill on these bonds is nearly $25,000,000. The cutting of timber is compulsory in many cases because of the provisions of the serial bonds, irrespective of the current prices obtainable for lumber.

The banks today are tiring of accommodating distressed lumbermen, especially so because many bonded operations have failed and the banks have lost heavily in the wreckage. Timber bonds are in bad repute today among many leading bankers, and the lumbermen are unable to secure the banking credit facilities to which they would often be safely entitled. The indiscriminate and often untrue accounting methods prevalent among the lumber manufacturers is an additional serious obstacle to their securing reasonable banking service. Under the banking regulations today, banks cannot regularly give good service to an industry unable to present an accurate financial statement, showing *correctly* the state of the business. In their accounting the lumbermen have not yet learned to speak the same language. Relief from this difficulty is available to the lumberman through his own efforts alone.

In the absence of adequate banking accommodations and under the pressure of heavy carrying charges on his timber, the timber owner has been forced to resort to increased cutting, with almost no regard for the market conditions, in order to make these payments, for which he has no other resources. The result has been that the supply of lumber is determined in large measure not by the demand of consumers of lumber, but by the demand of the banks for interest and by the demand of the communities for taxes on the great load of private timber reserves which are not now a source of reasonable profit, but, rather, an actual burden upon the industry.

The Capacity for Lumber Production

There is installed today in the United States a sawmilling capacity of over 100,000,000,000 feet. The maximum consumption in any one

year has been less than half of that amount, and in recent years it has been steadily declining. Naturally, either one-half of the mills remain continually idle, or, if all the mills are actively engaged, they must operate on the average to less than one-half capacity. I shall not attempt here to account for the existence of this great overcapacity, but shall merely point to it as an insistent influence toward relatively unprofitable production of lumber.

General Conditions

Inefficiency in the industry in all its branches exists in abundance. I desire to cite but a single illustration, showing concretely the evidence of uneconomical operating—among other faults, indeed—in the southern pine industry. I had made recently a tabulation of the total logging costs shown by the records of 119 operations. For the majority the cost fell between \$3 and \$4.50. The lowest cost figure was \$1.62 and the highest \$10.43. Similarly, with respect to 64 operations, the total cost of production from the stump to the car, ready for shipment, was between \$12 and \$14 a thousand feet, exclusive of stumpage. The lowest figure was less than \$10 and the highest was more than \$20. Such diverse costs make stable conditions of competition impracticable. The lack of standardization is a serious obstacle to efficient, intelligent industry. Competition on equal terms is impracticable under such conditions. As long as competition is so unequal, as long as cutting is forced for any cause whatsoever, and as long as unwise overcapitalized timber investments cry for immediate liquidation, so long will remain the tendency to overproduction, to relatively unprofitable business, and to the waste of a basic resource which has perilous possibilities.

I have purposely refrained from discussing the numerous incidental or contributory causes of the existing uneconomic organization of the lumber industry. Many of them, I believe, can be traced directly to the more fundamental causes I have described. I have not wished, moreover, in even a small measure, to disengage your attention from what appears to be the insistent basic problem—one that offers a profound challenge to public interest and to public policy.

I rejoice that the foresters of the United States are not willing to evade the challenge of this situation, which promises in many ways so vitally to affect the future activity of their profession in this country. It is my firm belief that there is no present economic condition which has a closer relation to the success of American forestry.

FOREST TREE PLANTING CAMPS

By J. S. Illick

Professor of Forestry, Pennsylvania State Forest Academy

The planting of forest trees becomes an established part of forestry practice in every country at some time of its development. Planting began more than a century and a half ago in the United States, but it was not until within the past fifteen years that it has been conducted on an extensive scale, and in accordance with the real fundamental principles of forestry. The recent increase in planting in the United States has been almost phenomenal. More than 30 million trees were planted for forestry purposes during the year 1916. The subjoined tabulation of the number of trees planted upon the State forests of Pennsylvania during the past eighteen years shows the general progressive tendency of the practice.

Year	*Number of Trees*	*Year*	*Number of Trees*
1899	1,000	1908	100,628
1900	1,500	1909	738,461
1901	0,000	1910	1,092,213
1902	5,000	1911	1,663,661
1903	1,600	1912	1,890,404
1904	7,700	1913	3,164,637
1905	40,000	1914	3,393,571
1906	99,550	1915	4,315,436
1907	37,930	1916	5,492,020
Total			22,045,311

The first trees were set out in 1899, and since then a rapidly increasing number has been planted each year, except in 1901. Present indications point to a still further extension of the practice, for over 8 million trees will be available for the planting operations of the spring of 1917. The experience obtained by the foresters, who have conducted the planting operations in the past, will be of inestimable value for subsequent planting.

Among the many important developments, the tree planting camp is probably the most significant, and yet, in many regions, the least known. The data and conclusions presented in this article have been drawn largely from the experience and accounts of foresters in charge of State forests in Pennsylvania and, unless otherwise stated, will refer to these forests.

Eleven planting camps were operated on as many forests during the spring of 1916. Out of a total of 5,492,020 trees set out on all the State-owned land, 2,781,540 were planted by men and boys receiving their board and lodging in camps. The location and general data concerning these camps follow:

State Forest	*Number of Trees Planted*	*Area Planted (acres)*	*Cost of Maintaining Camps*	*Total Cost of Plantations*[1]
Black Forest.............	559,900	567.9	$510.29	$2,526.87
New Bergen.............	411,050	379.5	395.16	1,882.32
Ole Bull.................	381,200	406.7	413.83	1,761.02
Blackwells...............	355,300	415.1	309.98	1,544.69
Stuart..................	318,400	189.7	280.75	1,588.65
Caledonia...............	209,450	120.5	250.50	1,005.49
Hopkins.................	150,640	99.8	374.35	1,220.04
Nittany.................	149,200	83.2	45.53[2]	707.32
Sinnemahoning...........	141,400	57.4	150.60	689.43
Two smaller camps.......	105,000	67.4	114.56	574.04
Total...............	2,781,540	2,387.2	$2,845.45	$13,499.87

[1] Includes cost of plants.
[2] Men supplied food which was prepared in camp.

Planting plans have been prepared for all the State forests of Pennsylvania, which now number fifty-two. A large number of these plans contain recommendations in favor of a still further extension of the practice of planting from camp. This growing tendency prompts the writer to describe their main features and problems, record the most important operating experiences of the past, and discuss their advantages and the questionable tendencies which are developing in connection with them.

Some of the planting sites are located in rather populous regions, while others are situated miles from the nearest human habitation. The labor supply in remote mountainous regions is usually very limited, and foresters in charge of planting operations, as a rule, experience considerable difficulty in recruiting full planting crews. The Black Forest State Forest comprises 30,000 acres, of which area 24,000 acres are barren or covered with a growth of bird cherry, aspen, ferns, and weeds. This entire acreage must be planted. The present supply of labor available for tree planting within a radius of 10 miles could not plant this area in a hundred years. In the midst of the forest is a forest community consisting of one forester, two forest rangers, one game warden, and their families. Towards the east from this

settlement by road there is no house for 9 miles, towards the south none for 8 miles, towards the west by trail none for 20 miles, and only one house in 12 miles towards the north. With such extensive areas in need of reforestation and no local labor available to do the work, the erection and maintenance of planting camps becomes obligatory. Laborers must be imported to do the work, and if imported, they must be provided with board and lodging.

The first important problem of a tree planting camp is the selection of a satisfactory site. The essentials of a good camp site are:

1. *It should be centrally located.* A carefully selected camp site may be used a number of successive seasons, if centrally located. Men should not walk more than three miles, and on an average, not over one and a half miles from camp to work. It is wasteful to consume much time and expend a large amount of energy on the road.

2. *It should be rather level and well-drained.* A level camp site simplifies the erection of buildings, tents, and bunks. The drainage is of great importance since planting operations are usually conducted in spring when the ground is full of water. A poorly drained camp site contributes much towards the discomfort of the workmen, whom it is often difficult to retain under the best possible conditions.

3. *It should be near a strong spring or a stream of pure running water.* A large quantity of pure water is needed for drinking, cooking, and laundry purposes. Great care should be exercised that the water supply is not contaminated, especially from stables, toilets, and kitchen refuse. Sanitary regulations are the product of foresight, and are necessary in the conduct of all modern camps. The camp team also needs water and the heeled-in planting stock must be kept moist.

4. *It should be easily accessible from the source of supplies.* The importance of this factor is usually underrated. No planting camp can afford to have many mishaps in getting supplies, whether they be kitchen provisions or planting stock. An entire planting crew may become disorganized because of a single hitch in getting the supplies for the kitchen. A satisfactory conveyance should be available at all times for the transportation of supplies. Telephones are of inestimable value to the managers of planting camps. They simplify the supply problem and afford a ready means of communication concerning forest fires which occur frequently during the spring tree planting season.

Two types of tree planting camps may be recognized, namely, the

temporary and the permanent. The temporary usually consists of tents, while the permanent may comprise log, frame, or stone structures. Tent camps have proved to be both practical and economical because planting operations rarely extend over more than six weeks. A camp accommodating 30 to 40 men may comprise the following tents:

(*a*) A single office and store tent, which is the headquarters and sleeping place of the forester in charge. It is the place where the camp business is transacted. A store equipment is indispensable but should be limited to necessaries, such as shirts, trousers, stockings, gloves, tobacco, candy, peanuts, and postage stamps. It prevents the laborers, who are apt to become restless in remote regions—especially on rainy days—from leaving under the pretext of getting tobacco or clothing. A supply of medicine for ordinary ailments, such as headache, colds, sprains, and bruises, should always be kept on hand.

(*b*) One kitchen tent in which the meals are prepared and the provisions stored. The rear part may be used by the cook and cookees for sleeping quarters.

(*c*) One dining tent in which the meals are served on two long board tables running lengthwise.

(*d*) Several bunk tents, the number depending upon their size. A 14 by 22 tent will accommodate 14 men and afford place for a heating stove. The bunks may be made of boards, lined with building paper and then filled with straw. Each workman furnishes his own "kips" or blankets.

(*e*) One lobby tent in which the men may spend their evenings and rainy days. It should be supplied with a stove, a few tables which may be used for playing cards and writing letters, and a number of wooden "deacon" benches. It may also be used for a general assembly place where the forester and visitors can give short informal talks in the evening to the planting crew. A crew will work much better if they are informed concerning the real object and significance of planting. No opportunity should be lost in disseminating information to the men who actually do the work. Tree planting time may be made as popular in the future as bark-peeling was in the past. An evening camp-fire also appeals to many workmen. It creates an atmosphere for story-telling and often stimulates "lumber-jacks" to relate their experiences and describe the forests of former days. Such features prevent the pendulum from swinging too far towards monotony and quietude.

(*f*) A stable for the animals, usually constructed of rough lumber, is also a necessary part of the camp, for a team or an equally reliable conveyance, is an indispensable feature of a well-organized tree planting camp.

The comfort of the workmen should receive first consideration in every camp. Each tent should be provided with a stove and an adequate supply of wood should be handy and ready for use. If stoves are not provided the bunks and blankets become damp and begin to mould in a very short time, and as a result of such uncomfortable conditions the workmen become dissatisfied and frequently leave. Each tent should be carefully inspected before it is occupied and seen to that it will withstand the severe rains and strong winds which occur frequently during the spring planting season. The best tent conditions are none too comfortable in spring time.

Greater comfort is secured in more permanent camps which usually comprise a single or several log, frame, or stone structures, locally called cabins or shacks, and a nearby stable. Some of the State forests already have cabins upon them. On the Blackwell State Forest a frame cabin, consisting of a lobby 16 by 22 feet and a kitchen 8 by 10 feet, was erected at a total cost of $242.80. This amount includes the cost of all materials, labor, grading and clearing. Eighteen men, a number sufficient to form an efficient planting crew, can be accommodated. An additional expenditure of $12.30 provided a spring house and a crude stable for two horses. On the Barree State Forest a log cabin was erected by the forester in charge and his ranger at a cost of $170.08, which included the cost of all material and labor. Such permanent structures have many advantages over tents. They are more comfortable, sanitary and homelike, and consequently prevent dissatisfaction among employes. Furthermore, they offer accommodations not only during the tree planting season, but may be used throughout the year by workmen engaged in road construction, cleaning fire-lines, making surveys, or lumbering operations, and by extra patrolmen during the fire season. Tools, nonperishable food, utensils, and other equipment may also be stored in them.

A sufficient supply of properly selected and well-prepared food is another essential of a tree-planting camp. The average menu resembles that of a modern lumber camp. Sample meals served in tree-planting camps are subjoined:

BREAKFAST

Oatmeal	Ham and eggs or Bacon and eggs	Fried potatoes	Hot biscuits or Bread and butter	Tea and coffee

DINNER

Salted pork	Boiled or roasted potatoes	Two vegetables Dried fruit	Bread and butter	Tea and coffee Pie

SUPPER

Fresh veal	Fried or baked potatoes	Two vegetables	Canned peaches	Hot biscuits or Bread and butter
	Tea and coffee		Cakes or cookies	

The cost of board per man per day during the 1915 and 1916 planting seasons ranged from 48 to 65 cents. One camp served 3,000 meals during the spring of 1916 at an average cost of $0.165 per meal. During the same spring another camp served 2,065 meals at an average cost of $0.215 per meal. An itemized account of the kitchen provisions used by the latter camp and the cost thereof is subjoined:

202	dozen eggs	$44.44	½	case corn beef	$3.90
341	pounds veal	40.61	50	pounds dried prunes	3.75
93	pounds butter	27.90	50	pounds cabbage	.65
23	bushels potatoes	27.60	1	case apples	2.75
108	pounds ham	21.99	1	case pears	2.60
1½	cases Karo syrup	3.38	1½	case corn	2.55
1	case Banner oats	3.25	1	bag onions	2.50
50	pounds evaporated peaches	3.00	9	pounds tea	2.40
3	bushels parsnips	3.00	1	case tomatoes	2.30
263	pounds sugar	21.10	1½	case peas	2.25
4	cases milk	13.50	1	pail mince-meat	2.18
2	barrels flour	13.50	1	box soda crackers	1.56
74	pounds pork	10.05	1	box sugar cookies	1.53
69	pounds lard	10.04	10	pounds bacon	1.10
31	pounds coffee	5.90	1	bushel carrots	1.00
1	case salmon	5.60	½	case beets	.90
1	case roast beef	4.60		Miscellaneous items: spices, soap, mustard, etc	32.83
1	keg pickles	4.50		Cooks and assistants	92.75
27	pounds beef	4.45		Hauling supplies	10.80
1	bushel beans	4.20			
	Total				$442.91

The above itemized account is given especially for those who contemplate ordering provisions for a camp, which task beginners usually regard as the most difficult of the entire planting operation. A more condensed or summarized account would have required less space than the preceding tabulation, but it would have had practically no value

to the camp organizer, whose most perplexing task is the ordering of subordinate items, which in the aggregate represent a considerable proportion of the total expenditure. Experience shows that care should be exercised in not ordering too large a stock of provisions, for it is, as a rule, easier to replenish the stock than to dispose of surplus. It also pays to buy vegetables, eggs, butter, and fresh meat from local farmers, if possible. The quality is usually better and the prices lower.

A general summary of the tree-planting camp operations on two State forests during the spring planting seasons of 1915 and 1916 follows:

	New Bergen State Forest		*Black Forest State Forest*	
	1915	1916	1915	1916
Number of trees planted..........	429,400	411,050	162,682	559,900
Area planted (acres)..............	418.4	379.5	148.5	567.9
Number of trees per acre..........	1,041	1,083	1,096	987
Wages per hour, including board...	$0.14	$0.15	$0.15	$0.15
Cost of plants....................	1,116.25	635.43	382.11	870.92
Cost of transportation............	30.43	56.13	9.55	79.46
Cost of board.....................	336.16	395.16	148.92	510.29
Cost of labor, including forester and rangers........................	670.90	795.60	314.78	1,066.19
Cost of planting per thousand......	2.49	3.03	2.90	2.96
Cost of planting per acre..........	2.56	3.29	3.19	2.92
Cost of plants per acre............	2.67	1.67	2.57	1.53
Cost of plants and planting per acre.	5.23	4.96	5.76	4.45
Value of land per acre.....	3.00	3.00	3.00	3.00
Total investment per acre.........	8.23	7.96	8.76	7.45

No planting cost is complete without an accurate and complete description of the existing growth upon the planting site. A dense and especially a thorny or vine growth impedes the progress of the planting crew. A thorny or briary growth is destructive to the clothing of the workmen, and makes planting uncomfortable, and, to a degree, hazardous. The density of the existing growth is a vital determining factor of the spacing of the trees, *i. e.*, the number planted per acre, which in turn is a potent influencing factor upon the cost of planting per acre and per thousand.

A wide range of growth conditions is usually present upon such extensive planting sites as those given in the preceding tabulation In order to facilitate description the growth present upon such planting sites can usually be grouped under a few distinctive types. The existing growth upon the 567.9 acres, comprising the area planted upon the Black Forest State Forest during the spring of 1916, may be

comprehended from the following description of four sample acres, each representative of a distinctive type of growth:

ACRE I.—Comprised 24,792 specimens of trembling aspen (1 to 15 feet high), 264 fire cherry, a few scattered specimens of other hardwoods, and a *sparse* growth of bracken fern, sweet fern, and briars.

ACRE II.—Comprised 2,900 specimens of fire cherry and 1,600 trembling aspens mostly from 5 to 15 feet in height, scattered specimens of other hardwoods, and a *moderate* growth of sweet fern, bracken fern, and briars.

ACRE III.—Comprised a decidedly scattered growth of bird cherry and aspen, and irregularly distributed groups of chestnut, black locust, red maple, sugar maple, and beech coppice. A *dense* growth of bracken fern, sweet fern, and briars covered the ground.

ACRE IV.—Covered by a rather dense, but interrupted, polewood-size growth of very inferior hardwoods, with a very limited sprinkling of white, red, and pitch pine.

The number of trees set out on the above planting site averaged 987 per acre, which indicates an average spacing distance of about 6¾ by 6¾ feet. The presence of such a variable growth necessitates the use of an adjustable spacing distance. Wherever no tree growth was present and the ground vegetation dense, the trees were spaced 4 by 4 to 5 by 5 feet, and upon the areas possessing a scattered growth of trees and a moderately dense ground vegetation the spacing was extended to 6 by 6 or 7 by 7 feet, while on a relatively small acreage with a rather dense tree growth, comprising some valuable species, and a sparse ground cover of vegetation the spacing was still further extended to 8 by 8 or even 10 by 10 feet. The average spacing distance on the 2,387.2 acres planted from camps during the spring of 1916 was a little over 6 by 6 feet.

In spite of the interfering growth present upon practically all the planting sites, the cost of planting was kept down to a commendably low figure, which bespeaks an efficient organization of the entire planting operation of which the camp was a vital part. In the future, forest tree-planting camps will be operated more extensively than in the past, for experience has already proved the following chief advantages:

1. *The planting is accomplished at a lower cost.* Immediately after planting, records are made and filed for each plantation established.

They show the lowest planting costs for planting operations with camps and the highest for small and remote operations which required the workmen to walk long distances to and from work each day. Past experience on the Blackwell State Forest shows that an additional cost of 16 cents per thousand is incurred for every mile walked by the crew in going to and returning from work. The average cost of all the planting operations upon State forests in 1915 was $2.96 per thousand. The cost of planting operations with camps remained below this amount, while operations without camps were usually higher and in five isolated cases exceeded $6 per thousand.

2. *Less time and energy is spent on the road.* This is of considerable economic importance, particularly in case of the Pennsylvania Department of Forestry, which allows its workmen time one way in remote operations.

3. *The planting of remote sites becomes possible.* Areas beyond the reach of local laborers can be reforested on an economical basis. This is often necessary, especially in case of protection forests.

4. *The execution of a rational planting plan is made possible.* Without camps planting is limited to areas near a local labor supply, which may not be the ones in greatest need of immediate reforestation. The establishment of protection forests about the headwaters of streams should take place immediately. Such a procedure requires the establishment of camps on account of the remoteness of the operations. A rational planting plan makes recommendations and outlines procedures which tend toward a normal arrangement or proper distribution of all the stands of a forest—one of the three prerequisites of a normal forest. This important feature of planting plans is, at the present time, often overlooked. It is, however, worthy of careful consideration, because stands are not portable, but obtain their permanent position in a forest at the time of their establishment.

5. *Supervision over the food supply and the resting hours of the workmen is secured.* Many willing native denizens and floating laborers receive an inadequate quantity and a poor quality of food at their homes and boarding places. Under such conditions their best efforts are not productive of satisfactory results. In camps the quantity and quality of food can be adapted to the work, and the resting hours can be so regulated that the energy of the workmen is not dissipated.

6. *Wider publicity concerning tree planting is obtained.* Tree-planting camps will become as popular as the lumber and bark-peeling

camps of the past. They are now receiving wide publicity while the ordinary tree-planting operations go on unheralded. In the spring of 1916 a newspaper man traveled 50 miles to a tree-planting camp in northern Pennsylvania for the purpose of "writing up" the operation.

7. *Places men in the forest during the spring fire season.* A tree-planting crew of 20 to 30 men, near at hand and ready to fight forest fires at any time, is a great protective asset to a forest. The spring fire season is at its height during tree-planting time, and fire-fighting tools are kept on hand at all the planting camps. The telephone connection, maintained between these camps and headquarters and fire-towers, facilitates the prompt calling out of the men at the early stages of fires.

These advantages of forest tree-planting camps, most of which are of vital economical significance, will naturally tend both to enlarge their present scope in regions where they are already established, and extend their use into new fields. While present experience recommends an extension of the practice, it also throws light on a number of tendencies which should be carefully and critically examined with the specific object of determining whether the development and ultimate outcome of the stands resulting from the present plantations will be satisfactory, or if a modification of the present procedure would be productive of better results. The two principal tendencies, which seemingly embody unfavorable features, are:

1. The planting of remote sites before the proper economic time.
2. The establishment of large plantations.

1. *The planting of remote sites before the proper economic time.* A tendency towards reforesting more or less remote areas previous to more accessible sites, has, in some localities, been recently discernible. A number of apparently valid reasons have been advanced in justification of this development. Recent stock surveys show that some of the most inviting and productive areas in need of artificial reforestation are located in remote regions. The high and relatively inaccessible plateaus of the Allegheny mountains comprise vast level areas with a fairly deep and fertile soil, and a sparse covering of woody vegetation. Such existing conditions make planting relatively easy, and consequently lower the cost of the operation. There may also be a compelling desire on the part of the forester to establish plantations in the midst of extensive denuded areas with the hope that in a few years the planted areas will become oases within acres of

desolation, and, due to the strong contrast, serve as impressive object-lessons.

While the above reasons apparently justify the planting of remote sites at the present time, they, however, cover only one phase of a good business, viz: economic production. To market a crop advantageously is just as essential to the welfare of a good business as to produce it economically. Market conditions, distance to market, and transportation facilities may make the profitable disposal of products derived from remote areas difficult, or even impossible, while similar products procured from areas nearer to points of consumption or manufacture may be marketed at a fair profit.

Thinnings, which are necessary for the rational development of any stand, may be deferred beyond the proper silvicultural time, or even omitted, because the yield therefrom would not pay the expense of the operation. The low net income from felling operations—both intermediate and final—is often directly attributable to heavy transportation charges, particularly, in case of remote operations. The Hartigs,[1] in writing concerning the selection of regeneration areas, enumerate ten determining factors which should always be carefully considered, one of which states explicitly that the annual regeneration areas must be so located, and when necessary so distributed, that the wood derived therefrom can be transported as easily and cheaply as possibly. It follows, then, as a rule, that the more remote a plantation the greater are its silvicultural and economical handicaps, and the less refined must be the methods of handling it. The adequate protection, as well as the rational development of remote plantations, is difficult and expensive, which more than counterbalances the ease and cheapness of their establishment. The executive officers and workmen generaly take less interest in plantations far removed from human habitations and traveled highways, than in those situated at points frequented by tourists and pedestrians.

The future economical development of remote forest areas cannot be foretold accurately enough at present to justify any deviation from ordinary procedures. Therefore, it seems logical that the development of a forest property should proceed from the most accessible part towards the more remote, that is, the forest, and that part of each forest which seemingly will be handled most intensively in the future

[1] Hartig, Dr. Theodore und Dr. Robert: Lehrbuch für Förster. Zweiter Band, s. 21. Stuggart, 1877.

should be reforested first. It should, however, be remembered that departures from the above rule are permissible, and often commendable, especially in case of such special projects as the development of protection forests about the headwaters of streams.

2. *The establishment of large plantations.* The size of plantations is a subject which has received very little consideration until recently. Heretofore, the small output of nurseries, and the relatively high cost of planting material, and the limited experience in the technique of planting have acted as natural checks on the establishment of large undivided plantations. All the older plantations are consequently small or average in size. During the past decade, however, many forest tree nurseries have been started and developed at such a phenomenal rate that they are now turning out millions of trees annually. The enormous output of these nurseries and the now relatively low cost of planting stock have stimulated the practice of planting to a degree formerly undreamed of. The present wholesale method of planting, as a rule, accomplishes the task at a cost considerably below that of the retail or parcel method of the past. It, however, embodies the questionable tendency of making large undivided plantations. During the past few years six plantations, ranging in size from 379 to 567.9 acres and averaging 444 acres, have been established in connection with tree-planting camps on State forests in northern Pennsylvania. A number of questions suggest themselves concerning this tendency. Can such large and undivided plantations be protected as adequately against fire, fungi, insects, wind and other destructive agencies as the same number of trees in smaller and scattered plantations? Do such large plantations form satisfactory units of silvicultural treatment and development? Will they fit into a rational plan of management or will they be cumbersome misfits?

The answers to these questions must be based upon empirical knowledge and not upon *a priori* judgments. American experience, however, does not shed much light upon these questions, because practically all the large plantations have been established so recently that the problems of protection, silviculture, and management, which have been met and in many cases successfully solved, contain few, if any, practical suggestions concerning the rational development and ultimate outcome of older stands. European experience in this particular field of inquiry, on the other hand, extends over a long period of time

and covers a wide range of conditions. German foresters[2] are by no means all of one mind concerning this subject of large versus small area management. The foresters—particularly silviculturists favoring natural seed regeneration—who are primarily concerned with the technical aspect of forestry, namely, the production of the crop, recommend relatively small regeneration areas, while those who are chiefly engaged in the business aspect of the subject, namely, the procuring of the revenue, favor larger regeneration areas. There is, however, general agreement among them that neither the very small nor the exceedingly large regeneration areas are the most desirable and practical.

In answer to the first of the above questions the Hartigs[3] have written that large regeneration areas are more difficult to protect against fungi and insects, suffer more from drought, sun-scald, frost and grassy growth, and result in a greater amount of windfall and windbreak than small regeneration areas. Mayr[4] states that the small-stand method of mixing species serves as a natural check upon the migration of calamities caused by insects, snow, and storm. Toumey[5] recommends that when large continuous tracts are seeded or planted it is often desirable to subdivide the area into 20 to 40 acre divisions separated from each other by suitable fire lines. The avoidance of large areas of young stands (especially important in conifers on account of fire) is advised by Roth,[6] who also states that it is almost certain that the next fifty years will demonstrate the dangers and losses in the United States which are sure to come with extensive unbroken areas of pure growing stands of pine. The foregoing opinions are authoritative, and show beyond a doubt that it is not safe to plant extensive undivided tracts to forest trees, particularly coniferous species. The writer has yet to find a single person who can offer an effective method of combating a forest fire, when well under way, within a pure stand of even-aged white pine or other evergreen conifers, in the thicket stage, *i. e.,* when 10 to 25 years old.

---

[2] Endres, Dr. M.: Grossflächenwirtschaft und Kleinflächenwirtschaft. (Forstwissenschaftliches Centralblatt, s. 401–412, August, 1913.) Also Wagner, Prof. C.: Gross-oder Kleinflächenwirtschaft. (Forstwissenschaftliches Centralblatt, s. 3–26, January, 1914.)

[3] Hartig, Theodore und Robert: Lehrbuch für Förster. Zweiter Band, s. 22, Stuggart, 1877.

[4] Mayr, Heinrich: Waldbau auf naturgesetzlicher Grundlage, s. 548. Berlin, 1909.

[5] Toumey, James W.: Seeding and Planting, p. 185. John Wiley & Sons.

[6] Roth, Filibert: Forest Regulation, pp. 122, 126. Ann Arbor, Mich.

At this stage of development such stands are an almost impenetrable thicket, and a veritable fire trap. It is next to impossible for any human organization to stop a fire within a stand under such conditions unless specially favored by natural agencies, such as rain, snow, dampness, and wind. The first reliable vantage points from which the fighting crews may work are the borders of the stands or plantations. Therefore, the less remote these borders are, that is, the smaller the stands, the less will be the acreage burned over and lower the consequent loss. The present status of the fire problem, and the white pine blister rust and weevil situation, should automatically tend to arrest the present tendency of establishing 100 to 500 acre plantations.

There appears to be general unanimity among European and American foresters concerning the second question. Mayr[7] saw in the small stand the only sure means of keeping the pure stand within proper limits of insuring the retention of valuable species, and of making possible the proper and timely conduct of eventual cleanings, thinnings and accretion cuttings. According to his point of view the establishment of species in small plantations was in full accord with the naturalistic fundamentals of silviculture which required that each species must be planted upon the particular site to which it is best suited. This is practically impossible in case of large, pure plantations, except where extensive areal uniformity of habitat exists, which is a very rare occurrence. He also states that the necessity for the small stand increases the warmer the climate, the better the soil, and the greater the number of valuable species inhabiting the region, and recommends that the subcompartment—the stand of today—be subdivided into stands of 1 to 8 acres each, and only in special cases should the aggregate area of stands be increased to 12 acres. Wagner[8] goes a step farther and recommends that each compartment (30-50 acres) should gradually be transformed into an independent cutting series (Hiebszug), comprising a variable number of stands or age gradations. Roth[9] states that good silviculture calls for *small cutting areas,* and furthermore maintains that it is much easier to reproduce a stand of timber, whether by natural or artificial reproduction, if the

[7] Mayr, Heinrich: Waldbau auf naturgesetzlicher Grundlage, s. 546–551. Berlin, 1909.

[8] Wagner, C.: Der Blendersaumschlag und sein System, s. 258. Tübigen, 1912.

[9] Roth, Filibert: Forest Regulation, p. 122. Ann Arbor, Mich.

area to be covered is small and surrounded by forest. It follows, therefore, that in order to develop a forest rationally from a silvicultural point of view it must be made up of a large number of small stands which offer many points of attack for reproduction, reinforcing, cleaning, thinning, and other improvement operations. A forest composed of large continuous stands is not flexible enough for practical and efficient treatment.

The third question does not fall within the scope of forest protection nor silviculture, but within the field of forest organization—a branch of forest management. Forest organization does not only indicate the most desirable size for the units of management and units of treatment, but also specifies a minimum limit below which it is not practical to differentiate stands and a maximum limit above which they are unwieldy. If there was no minimum limit one would ultimately come down to a single tree management which may be feasible in the teak forests of India and in an arboretum, but is not practical in American forests. According to recent German regulations the minimum size to which stands are differentiated varies from one-half acre in Saxony to two and one-half acres in Prussia and Bavaria. One hectare (2.47 acres) appears to be the generally accepted minimum. According to recent instructions issued for the state forests of Austria a minimum size of .6 hectare (1.5 acres) for definite organization and 2 hectares (5 acres) for provisional work is specified. Stand differences of less extent are usually recorded in a written description. No binding prescriptions can be issued, but for practical purposes the minimum size may be taken as 1/50 of 1 per cent of the total area of an average-size forest. Hence, in a forest of 20,000 acres the differentiation may be carried down to about 4 acres, and in a forest of 60,000 acres down to 12 acres. These figures do not indicate absolute limits which must not be crossed, but rather serve as warning signs below which the size of plantations, and the stands resulting therefrom, should not be reduced unless compelled by circumstances or required for experimental purposes, because extremely small stands cost more to establish per unit of area, necessitate an ultra-intensive system of management, require a very intricate road system, make inspection and mapping difficult, and present almost unsurmountable obstacles to the forest organizer working towards a normal arrangement of the stands of a forest. Overlarge stands, on the other hand, are equally undesirable and im-

practical. The most desirable size of stands for the orderly management of a forest property may be approximated from a consideration of the size of compartments, the generally recognized units of management, which in some cases coincide with stand or else embrace a number of stands. According to Martin[10] compartments should have the following average size: Broadleaf species, 60 acres; pine, 50 acres; spruce, 37 acres.

Only in special cases and under exceptional conditions do European authorities recommend compartments of more than 100 acres. Because of the size interrelation between compartments and regeneration areas in Europe and the less intensive management in America at the present time, 100 acres may be taken as a conservative maximum for the size of plantations and other regeneration areas. Unbroken plantations of coniferous trees of more than 50 to 100 acres should rarely, if ever, be made. The establishment of overlarge plantations (250 to 550 acres) is an unsafe venture. They are unwieldy, and do not fit into a rational plan of continuous or sustained yield management of forests with an average aggregate area of about 20,000 acres. They may be a means of restocking denuded areas rapidly, but they do not assist in bringing order into a forest property.

---

[10] Martin, H.: Forsteinrichtung, s. 29. Berlin.

THE BIOLOGY OF LODGEPOLE PINE AS REVEALED BY THE BEHAVIOR OF ITS SEED[1]

By Carlos G. Bates

Forest Examiner, Forest Service, Denver, Colo.

In again bringing up a subject which has been so much written of, I have a threefold object, namely, to make my hearers somewhat familiar with the nature of investigations which are being conducted by the Forest Service, to suggest a slightly new viewpoint in the treatment of bionomic studies, and, least of all, to pretend to add a mite to our knowledge of the fundamental facts regarding lodgepole pine.

The first object is not one of propagandism. However, some friendly critics of the Forest Service have recently, consciously or unconsciously, conveyed the idea that forest investigations at present are not producing a proper quota of fundamental data, usable as the foundation of scientific silvicultural practice. Notable among recent articles in this tenor are Dr. Fernow's[2] "Suggestions as to Possibilities of Silviculture in America" and Barrington Moore's[3] "Relation of Forestry to Science." I must confess to feelings, at times, entirely in keeping with the ideas expressed by them. It has struck me that our experimentation has been of too limited a scope, representing, as it so often does, a purely local test of the "best method" of performing some silvicultural operation. This is true of nearly all of our work in reforestation, natural regeneration, and thinnings. Yet, I think it is erroneous to assume that because the working plans for these investigations carefully avoid any mention of the broader principles at stake, the results will fail to bring out the fundamental data that truly scientific foresters want and must certainly have. I think you will agree with me that, in general, scientific principles and specific biological characters are to be established not by assuming an hypothesis and searching for proof of it, but by free-minded analysis of all the data bearing on the point, from all possible sources, each of which must

---

[1] Presented at the New York meeting of the Society, December 29, 1916.

[2] Fernow, Dr. B. E., "Suggestions as to Possibilities of Silviculture in America." Proc. Soc. Am. For., XI, 2.

[3] Moore, Barrington, "The Relation of Forestry to Science." For. Quarterly, XIV, 3.

reflect a certain local character. I feel, then, that our present need is for more analytical treatment of the enormous collection of data which are available from numerous, and in many cases very simple, experiments. Only as we consider these small local experiments as sufficient unto themselves, and refuse to analyze and correlate them, are we in danger of stagnating.

In going over the data which have been obtained in a number of forestation experiments involving lodgepole pine, I have discovered so many facts of interest, quite apart from the problem of reforestation, that it has seemed to me that these facts told a story in themselves, and that from them, without any first-hand knowledge of the tree, one might trace almost the complete life history of lodgepole pine. Ordinarily we think of the natural and artificial regeneration of a species as two quite distinct problems, and, so far as I know, the intimate relation between what we call "silvical characteristics" and what we consider to be the principal problems in reforestation, has not been generally recognized. Very recently, Professor Toumey[4] has brought out this relation in his text-book on the artificial growing of trees. I therefore wish to bring to your attention the desirability of using forestation results in the study of natural reproduction and in the determination of bionomic characteristics. This cannot be done better than by reviewing briefly the nature and results of experiments with lodgepole pine.

A few years ago we were confronted with the difficult and expensive task of collecting large quantities of the seed of this and other western species for use in reforestation. The problem of doing this at a reasonable cost led immediately to experiments to determine when and where seed was produced in the largest quantities, and how seed could be extracted most readily from lodgepole cones. The seed production studies covered only two stands, from which the crops have now been collected for five consecutive years. Further extension of these studies was prevented by the realization that intensive studies could give us biological data only if extended over a long period, and could hardly solve the immediate problem in a general way. Seed extraction studies were carried on, at first, wherever practical operations were under way. The difficulty of fully controlling conditions in large kilns, however, soon led to the abandonment of this method,

[4] Toumey, James W., "Seeding and Planting in the Practice of Forestry." New York, 1916, pp. 476.

and the latest and most reliable results have been obtained from an experimental, calorimetric kiln, in which were treated cones from two quite different sources, both in a green state and after various periods of air drying. Both seed production and seed extraction studies led, in the final analysis, to the germinability of the seed produced. Hence there was developed a system of seed testing which has been previously described,[5] and which was applied not only to seed extracted in the course of experiments, but to all seed used in forestation operations. The germination tests with lodgepole pine have now reached an aggregate of little less than two thousand, each involving 500 seeds. A large mass of data of great value was collected in this routine process.

Finally, it became obvious that since the conditions for germination in the greenhouse were so much more favorable than could be expected in the field, there was little possibility of securing the full greenhouse germination, and for the economic, yet successful use of the seed in forestation, it was decidedly necessary to have some measure of the field possibilities of each lot of seed. Hence there were made during three seasons, comparative tests of the greenhouse, nursery and field germination of a number of different seed lots, the last being performed not only with all of the seed lots under identical conditions, but with each sown at a point in the field near its source.

With this brief description of the work which has been done in various lines of experimentation, I wish to point out a few of the conclusions which may be drawn from an analysis of the results. First, what is shown with regard to the origin, migration, and present habitats of lodgepole in our limited region. The greenhouse germination tests show that lodgepole pine is much slower in its germination than either Douglas fir, Engelmann spruce, or yellow pine, requiring thirty-one days for what these other species accomplish in twenty-one to twenty-five days. The field tests, also, show that the seed has much of the "hang-over" quality of *Pinus monticola,* germinating nearly as much in the second as in the year of its sowing. These facts point to an origin at a high northern latitude. When we consider, also, that seed from northern Wyoming germinates almost as promptly as that from central Colorado, while Douglas fir seeds from these two localities show decidedly different characteristics, it becomes apparent that

[5] Bates, C. G., "The Technique of Seed Testing." Proc. Soc. Am. For., VIII, 2.

the species has adapted itself very slightly to its new conditions. In short, then, it is both a recent and rapid migrant from a northern source.

Consider now the facts that the tree produces some seed almost every year, that a good crop of seed means at least 200,000 germinable seeds per acre of forest, and that, in addition, there are always held on the trees cones amounting to two to ten times the volume of an average crop, and the possibility of its rapid migration is readily seen. It appears, also, that the keeping quality of the cones must be a large factor, making them especially attractive to squirrels and other rodents which cache their winter's food supply.

All writers[6 7] on lodgepole, I believe, have agreed that this species is extremely partial to siliceous soils. Certain it is that within its main range it has invaded almost all granitic and glacial soils, while leaving Douglas fir to hold lava and limestone soils in many instances. Our field sowings of lodgepole seed have shown that, under average climatic conditions for this region, germination occurs readily in sandy or gravelly soils whose capillarity[8] is 10 or 15 per cent, but is practically prohibited by a capillarity of 30 per cent, which would be met with in some limestone, lava, and alluvial soils and those of large humus content. Echard tests of these same soils, using lodgepole seedlings, show that the wilting coefficient for this species is very high, amounting usually to 22 per cent of the capillary moisture of the several soils, while Douglas fir and Engelmann spruce coefficients are only 12 and 16 per cent, respectively. The nonavailable percentage for lodgepole also rises very rapidly with the presence of alkali in the soil. These facts bespeak, physiologically, a small power for drawing moisture from the soil, and point to the fact that lodgepole in its native habitat unquestionably grew almost wholly on siliceous soils. Of greater present import, however, is the relation of these facts to the poor quality of lodgepole when growing, particularly on limestone soils, its inability to invade the so-called "parks" within its type, which are usually slight depressions having more or less alluvial soil, and finally the importance of exposing the mineral soil to secure reproduction.

---

[6] Mason, D. T., "The Life History of Lodgepole Pine in the Rocky Mountains." Bull. 154, U. S. D. A., F. S.

[7] Tower, G. E., "Study of the Reproductive Characteristics of Lodgepole Pine." Proc. Soc. Am. For., IV, 1.

[8] This expression refers to the moisture-holding capacity of a 5-inch column of soil against the force of gravity, 48 hours being allowed for drainage after saturating.

Our field tests have shown that, with the ideal soil, the relative chances for lodgepole germination are 91 per cent in northern Colorado, 49 per cent near the southern limit of the range in Colorado, and about 57 per cent in the Pikes Peak region. This is the response of the species to the varied climatic characters of these localities. Considering that under the best of these conditions probably not one seed in a thousand is permitted to produce a tree, it is readily seen that in the other localities an extremely slight barrier in the form of an inimical soil, or a subnormal season, would completely prohibit lodgepole reproduction. From consideration of the climatic element at the outskirts of the range, therefore, it appears highly probable that lodgepole has already reached the limits of its rapid migration. Further migration will doubtless result from the development of those qualities of vigor in the seed which the central Colorado form has been shown to possess in a slight degree.

What now of that very peculiar condition in lodgepole which causes it to retain so many of its cones, unopened, on the limbs, a phenomenon which has the most important bearing on the reproduction of the species, especially after fires. Extracting tests give a number of valuable facts. All collections of cones contain some which will not open by air-drying. Of these, many are not influenced by artificial drying at 110° F., but most of them open at 140° F., and only a very few plainly defective cones resist a temperature of 170° or 200°. In the siliceous form of lodgepole these resistant cones appear to be of normal development, but are very heavy, and either contain water in excess, or, as suggested by Clements,[9] unusual quantities of resin. The fact that in this form the number of such cones decreases rapidly with continued air-drying, however, tends to controvert the theory that the moisture is held in the cones by a heavy resin coating. These cones produce seed of normal germinability. In the limestone form, resistant cones are generally under-developed, their number increases if the cones are air-dried and become hard and fixed, and the seed from them is of comparatively low germination. Perhaps the most important point in this connection is obtained from a purely physical consideration of the heat requirements of cones. Opening of fresh green cones is accomplished by the utilization of about as much heat as would be required to vaporize an amount of free water equal

[9] Clements, Dr. F. E., "The Life History of Lodgepole Burn Forests." Bull. 79, U. S. F. S.

to that given off by the cones. But opening of cones after this free-water content has been lost in air-drying, involves the use of two to four times the theoretical heat units required to evaporate water. Furthermore, cones from a limestone soil require 15 per cent more heat than those from a siliceous soil. It, therefore, seems to be plainly indicated, as Clements has suggested, that opening of cones requires more than a mere drying of them; it requires a certain change in moisture content in a given time. We can now go much farther and say that this change will only be effected, with cones already partly dried, by a tremendous expenditure of heat energy. It is believed that this energy is necessary to overcome the avidity of the cell contents for moisture. The requirements of the limestone cones seem to point to the presence of salts, such as calcium chloride, which have a strong avidity. Be that as it may, it appears that in nature we have at least three distinct causes for the retention of cones, namely, unfavorable growing conditions, such as a limestone soil,[10] causing subnormal development of cones; factors such as the late development of the individual cones which may cause an unusual flow of both pitch and sap to them; and finally, the insolation of the cone, which may be such as to open it immediately, or may dry it slowly, and cause it to become fixed. Such cones are given a good opportunity to open only after years, when the pedicel breaks or the foliage falls away from the limb and exposes it to direct insolation. The greater number of persistent cones in dense stands points to the last cause as the most important one. Whatever the *cause*, the effect on silviculture should be evident. Cone retention, which we can only look upon as an abnormal physiological phenomenon, is directly helpful to the forester. It insures a crop of seed at any time, and we may confidently expect that silvicultural cutting of almost any character will release vast numbers of seed, both from the trees cut and from those left standing, the latter resulting from the accession of more light and heat to act upon unopened cones, and from better growing conditions for the production of later seed crops. In fact, I may say, as a closing word, that to my mind, throughout the area in which lodgepole is already established, silviculture will never confront a failure of reproduction due to lack of seed. Our problem will be to secure cutting heavy enough to insure the soil and light conditions which this species de-

[10] Tower assumes a limestone soil to present favorable growing conditions, whereas this is true only for a few species specially adapted to it.

mands, not so much for its germination as for the development of seedlings after germination. Our greenhouse work, the studies of Boerker,[11] and common observation of germination in the forest have shown that light is not a necessity in securing germination.

Other phases of this interesting study of lodgepole seed, it is hoped, may be presented at a later date.

[11] Boerker, R. H., A thesis, "Ecological Investigations Upon the Germination and Early Growth of Forest Trees." U. of N., Lincoln, January 1, 1916.

THE PACK RAT AS AN ENEMY OF NATURAL REPRODUCTION ON THE ANGELES NATIONAL FOREST

By Edward N. Munns

Forest Examiner, Forest Service

In the late summer of 1915 the attention of the writer was drawn to a number of dead Jeffrey pines (*Pinus jeffreyi*), the needles of which were just beginning to brown. A close examination of these showed the damage to have been caused by the girdling of the stem by some animal which was supposed at the time to be a porcupine. Later a more detailed examination of the area was made and a number of fresh wounds were seen on both branches and stems of these young pines. In order to ascertain definitely the marauder a number of steel traps were set at the base of some of the trees and the following day a large pack rat (*Neotoma fuscipes mohajensis*) was taken.

Smaller traps of the guillotine type were then placed in the branches of several trees which showed fresh work. That night two more rats were taken, showing fairly conclusively that the work was that of a rat and not a porcupine. A live rat was caught later and by considerable manipulation several incisions in the tender bark of a small branch were secured. The teeth marks on this branch and those on the pine trees where the damage had been done were carefully compared under a hand lens and showed indubitable evidence that they were caused by one and the same animal. S. E. Piper, of the Biological Survey, was asked to compare the evidence and he declared this the work of rats.

To determine the action of the rats and the amount of damage caused, a plot was laid out in this area of chaparral, taking in about a fifth of an acre. All the trees were marked, measured, and examined as to the nature of the injuries and their location. On this area there were 109 trees ranging in height from 6 inches to 25 feet, the largest one having a diameter of 6 inches at the ground, while there were present 13 rat nests of which 4 were uninhabited. It has been found lately by A. F. Taylor, of the Biological Survey, who has conducted careful experiments to determine effective methods for controlling these animals, that but one rat normally inhabits a nest. From the number of inhabited nests there were therefore 9 rats present on the

TABLE 1.—*Damage to Jeffrey Pine Trees by Pack Rats According to Height Class and Location, in Chaparral Sample Plot of about One-fifth of an Acre in Angeles National Forest, San Bernardino County, California*

Height of trees in feet	Total trees		Number killed				Number seriously injured				Number slightly injured				Number uninjured			
	Number	Per cent	Open	Open brush	Dense brush	Total	Open	Open brush	Dense brush	Total	Open	Open brush	Dense brush	Total	Open	Open brush	Dense brush	Total
1......	20	18.4	..	..	1	1	..	..	..	..	..	..	..	..	13	6	..	19
2......	24	22.0	..	1	1	2	..	1	..	1	2	1	..	3	12	6	..	18
3......	5	4.7	..	1	..	1	..	..	2	2	1	..	..	1	1	..	..	1
4......	20	18.4	..	2	6	8	..	2	3	5	2	..	2	4	3	..	..	3
5......	6	5.5	..	1	1	2	..	..	1	1	2	..	..	2	1	..	..	1
6......	11	10.0	..	2	5	7	..	..	2	2	1	..	1	2	..	..	..	..
7......	3	2.7	..	..	2	2	..	..	1	1	..	..	..	..	..	..	..	..
8......	10	9.2	..	..	2	2	..	1	3	4	..	..	3	3	1	..	..	1
9......	1	.9	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..
10......	4	3.7	..	..	..	..	..	1	1	2	..	..	..	..	..	1	..	1
11......	1	.9	..	..	..	..	..	1	..	1	..	..	..	..	..	..	..	..
14......	1	.9	..	..	..	..	..	..	..	..	..	..	1	1	..	..	..	..
20......	1	.9	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1
25......	2	1.8	..	..	..	..	..	..	1	1	..	1	..	1	..	..	..	..
Total..	109	100	..	7	19	26	..	6	15	21	8	2	7	17	31	14	..	45

area with a number of nests not far from the boundary of the plot. Since the area was laid out there has been no attempt to reduce the number of rats on the plot and an examination of the area in the season of 1916 showed that 9 nests were still inhabited.

The damage done by these rodents to the natural reproduction existing on the plot is shown in Table 1, in which the location of the trees with respect to the brush is indicated by the columns headed "open," "open brush," and "dense brush." "Dense brush" indicates a density of more than .5, "open brush" of less than .5, and "open" the absence of brush or its presence in such small amounts and of such intolerant species, as sage, as to make it practically negligible.

In this table trees which are designated as being severely injured are those which are so badly damaged that their existence is placed in jeopardy. Only very little further work would be required to kill the tree, while its growth is probably inhibited. The slightly injured trees are those with small injuries such as the loss of side branches, gnawings on twigs or stems, and superficial wounds which do not affect seriously the growth and development of the tree.

The trees that have been killed died as a result of girdling. In nearly every case the bark on the main stem has been almost entirely removed from the ground line up to the topmost branches or to that point on the stem where the needles still persisted, while the side branches have suffered in a similar manner. The presence of needles, whether dead or alive, appears to act as a deterrent to further action on the part of the rat, for it was noted that no damage of any nature was in evidence beyond them except where the stem of an adjacent bush came between the nodes. In this latter case, stems were cut off or slight damage was done by barking. Table 2 shows the location of the girdling for each size class where the trees were killed, though some bark still remained in places on the stems.

TABLE 2.—*Number of Trees Girdled, According to Height Class and Height at which the Girdling Occurred*

Height trees in feet	*Total trees killed*	*Location of Girdling by Feet from Ground* First	*Second*	*Third*	*Fourth*	*Fifth*	*Sixth*
1	1	1	.	.	.	.	.
2	1	1	.	.	.	.	.
3	1	1	1	.	.	.	.
4	8	8	6	5	.	.	.
5	2	2	2	2	2	.	.
6	7	5	7	7	7	6	.
7	2	2	2	2	2	2	.
8	2	2	2	2	2	2	1
10	1	1	1	1	1	1	.

It is to be noted in Table 1 that the killed trees were in close proximity to brush, one-third being in open and the remainder in dense brush. The same proportion holds true for those trees classed as seriously damaged. On the other hand, 9 of the trees with slight injuries were in the brush and 8 in the open, and, of the trees with no injury, more than twice as many were in the open as in the dense brush. These data are summarized in Table 3.

TABLE 3.—*Damage to Trees According to Location*

Location		*Total trees*	*Trees killed*	*Trees severely injured*	*Trees slightly injured*	*Trees not injured*
Open	Number...	39	0	0	8	31
	Per cent...	100	0	0	20.6	79.4
Open brush	Number...	29	7	6	2	14
	Per cent...	100	24.1	20.7	6.9	48.3
Dense brush	Number...	41	19	15	7	0
	Per cent...	100	46.3	36.7	17	0
Totals	Number...	109	26	21	17	45
	Per cent...	100	23.7	19.4	15.7	41.2

In general, the distance of the tree from an inhabited nest has considerable bearing on the damage done. If a near-by tree stands in the open, however, it is safer than if it were at a much greater distance, as the cover conditions are then the more important. Short open spaces between dense patches of chaparral are no drawback, but a wide open space in the cover is studiously avoided. In brush of fairly uniform density, the trees will suffer more severely than those in open brush or in brush of a patchy character, and this work is confined to that part of the tree which does not appear above the crown cover unless the chaparral forms an understory to a higher tree cover. It is probably due to this fact that this destructive activity of the pack rat escaped notice for so long.

The amount of work done on a single tree is astounding. The most remarkable case which has come to my attention is a Jeffrey pine 12 feet in height and bearing 480 scars visible on the surface. This tree, which was 30 years old, had 17 branches on it below the point at which the needles were persistent, and of these 16 had been injured in one way or another, while 24 of the twigs had been cut off. There were 445 scars on these branches, each scar being separate and distinct. On the main stem of the tree there were 35 abrasions, some of the bark being removed in a broad strip 6 inches long, while at 8 feet from the ground the tree was almost completely girdled for nearly a foot, two of the larger lower branches being killed in this manner.

Only two things appear to prevent rat damage: the presence of needles, and the breaking of the bark into plates and scales. From previous observations it is known that this rat can make his way over needles, but it is quite probable that in these cases the needles bent outward and away from the stem, affording a means for getting over them. In the case of the reproduction, however, both dead and live needles are more or less reflexed and bent back towards the stem, forming an inverted spine-tipped cone which restrains the rat from further progress in that direction.

The flaking and breaking of the bark is equally effective. Occasionally the bark of very young Jeffrey pines is rough, scaly, and broken, but this feature in the reproduction is not a common one and is found in relatively few scattered trees throughout the timbered belt on the Angeles Forest, as far as I am aware. As the tree grows larger the bark eventually breaks, although trees of the common type do not show this cracking to any extent for from 10 to 20 years, and then this process proceeds upward on the tree at about the same rate as the tree grows in height. This bark is always thicker and heavier than the smooth bark, though to all appearances it is as juicy and as tender inside as the smooth bark.

From observations covering two years it has been found that the damage occurs in the late summer or fall, from September to November, and seems to depend on the character of either the spring or the summer season. In summers when showers are not uncommon the amount of injury is negligible, but, following a dry summer and with an equally dry fall, the rats appear to be more active and to do the greater amount of damage. To prove this definitely, however, requires still further work.

If the theory here advanced is correct, it is relatively simple to account for this activity on the part of these rodents on the ground that they are searching for moisture. Chaparral bark, it is known, is a common source of food, and as the rats have no access to water, it is probable that all the water required for sustenance is supplied by their food. In the late summer, even the rather succulent *Ceanothus* bark becomes dry and it is quite natural that the rat should go to the source of the most moisture, which without doubt at this time is the pine bark. It is quite possible that the presence of resin in the pines is a repellent, but in times of a lack of water this is not enough to check the animal.

That the rat is a factor in the number of trees in the various height classes in a stand can not be doubted. Table 4, which gives the result of several measurements of trees growing either in the open or among sage brush and of the trees on the sample plot, shows this very plainly.

TABLE 4.—*Number of Trees by Height Classes in the Open and in Brush*

Height of trees in feet	*Trees in open without rats* *Number*	*Per cent*	*Trees in brush with rats* *Number*	*Per cent*	*Difference between trees in brush and trees in open* *Per cent*
1	37	23.9	19	22.9	− 1.0
2	29	18.6	22	26.5	− 7.9
3	26	16.8	4	5.0	−11.8
4	16	10.3	12	13.9	+ 2.6
5	12	7.7	4	5.0	− 2.7
6	8	5.1	4	5.0	− .1
7	6	3.8	1	1.2	− 2.6
8	10	6.4	8	9.7	+ 3.3
9	4	2.6	1	1.2	− 1.4
10	2	1.4	3	3.5	+ 2.1
10–12	1	.7	1	1.2	+ .5
12–14	1	.7	1	1.2	+ .5
14–16	..	....	..	....	......
16–20	1	.7	1	1.2	+ .5
20–25	2	1.4	2	2.5	+ 1.1
Totals........	155	100	83	100	

Besides the actual damage done to the trees, there is a secondary damage which might at any time become more important than the rats, namely, the bark beetle, *Dendroctonus valens.* On the plot in which most of the work described here was done, 3 of the 26 dead trees showed that this insect had been present before the death of the tree; 12, or 57 per cent, of the trees seriously injured were affected; and 6, or 35 per cent, of the trees slightly injured had pitch tubes, Altogether a total of 21 trees, or 20 per cent, of the entire stand had been hosts for the beetle. Thus, on a large area of young trees, whether natural or artificial, if the rats are not kept within bounds the trees may be wounded and the beetles therefore attracted, with the resulting danger of an infestation which might sweep off the entire stand.

The damage done by the rat has an important bearing on reforestation work because of the difficulty of poisoning the rodents which are so abundant in the chaparral, and because of the slow growth of the trees. Stem analysis of nearly 100 trees has shown that at the height of 7 feet there is a difference of 8 years between trees grow-

ing in the open and those growing in the chaparral, since it requires 15 years for a tree in relatively open conditions—such as in sagebrush, sumac, and rose thickets—to reach this height, while in the dense chaparral—oak, buckthorn, manzanita, and chemise—the tree requires 23 years. Most trees growing in the chaparral are just beginning at this age to push their heads above the top of the brush, and, as the bark does not begin to break into plates until the tree attains this age, it is in danger for about 7 more years, or until it reaches the age of 30.

Not being out of danger for this length of time, it would require repeated poisonings on each area to prevent the rat from again becoming a pest, since only a few rats would be necessary to repopulate the area as thickly as before in 10 years' time. The study of the sample plot showed that 24 per cent of the trees were killed and 19 per cent were so badly damaged that it would require but little further work to kill them. In other words a total of 43 per cent of the stand had been placed in jeopardy or killed by 9 rats in a period of but 2 years as a study of the callosus disclosed. It would appear, therefore, that at least three treatments in addition to the initial one would be necessary on an area artificially stocked, in order to keep the rats so in control that the loss would not be severe. This would mean a large total cost, possibly as high even as $10 an acre, for protection alone during the first 30 years in the life of the stand.

A FOREST POLICY FOR CALIFORNIA[1]

By D. T. Mason

Professor of Forestry, University of California

I want to talk about, first, the ideal condition of which forestry may be brought in California during the next hundred years; second, the present condition in California; and finally, the action needed to change the present condition into that ideal future condition.

In the year 2016 our ideal California is to have a population of 25,000,000 people. The State has the natural resources which will support that number. But to domicile comfortably so large a number there must have been brought about an ideal coordination in usefulness between the valley lands and the hill lands. The valley lands will be producing their utmost and the hill lands will be doing whatever it is in their power to do to help the valley lands produce that utmost. There is said to be in California somewhere between 25 and 30 million acres which grow, or can grow, forests. A hundred years from now the men in this room will have produced through their personal efforts and enthusiasm, applied directly or transmitted through others, the situation in which all of these forest lands will be in their highest use. Much of the Coast Range country, which is now producing oak and other scrubby trees, will then be producing real forest trees. Much land that is now producing nothing at all, or at most brush, will be green and pleasant to look upon, even if it is not producing very valuable timber.

Those 25 or 30 million acres will be managed with three great main purposes in view: To produce timber, to regulate streamflow, and to provide recreation. It is hard to tell which of these three purposes will be the most important, but, if forests are as potent in regulating streamflow as we believe they are, that purpose will be the most important. Second in importance I am going to place recreation, although realizing clearly that the commercial value of the forest in producing timber will also be very great.

It is roughly estimated that these forest lands have an average productive capacity of 150 board feet per acre yearly, which would give an annual product of 3¾ billion feet, or over three times the

[1] Read before the California Section of the Society of American Foresters.

present annual cut in California. With stumpage at a hypothetical value of $10 per thousand feet, this annual product will be worth 37½ million dollars. The forests will be operating at their maximum capacity in producing timber, so far as that is consistent with the other two main purposes, for the timber will then all be needed. We may not use very much of it in the form of lumber as it is used today, but we will have other important uses for it, such as for paper, alcohol to drive our airships, breakfast food, etc. Of course, to secure anything like the maximum yield and to permit such forestry at all a thorough system of protection throughout the State will be in operation. Protection will be easier then than it is now, for the sentiment of the people will be entirely favorable to it. They will realize how important it is. It will also be easier because the forests will have been managed long enough to make them far more easily accessible and to get rid of much of the dangerous débris. The management of the forest industry from the handling of the seedlings to the conversion of the product into useful articles for mankind will be on the highest technical plane.

The 6 million horse power estimated to be available will have been developed from the waters flowing in the State, and perhaps with the best of forest management this amount may even have been increased materially. It will move the trains on the railways; it will heat the houses; it will pump the water for irrigation; and irrigation itself will be far more extensive than at present—thanks to better utilization of streams now flowing, to pumping water from underground storage places, and to the better regulated streamflow. With California developed so intensively, the use of the forests in preventing floods will be of the highest importance.

While California is already the greatest recreation State in the Union, and now derives a good share of its income from tourist travel (not less than $25,000,000 per year is said to be brought into southern California alone), it will be far more important in the future. A wonderful highway system will exist then, the logical development of the splendid system now being brought into existence. The trees planted along these roads will make them far more attractive than they are now. While the highways will be tremendously important economically and in attracting tourists, an enlightened public will recognize that the forests are still more important, and the people will spend money freely in their protection and development. Millions

of people will be coming to this State annually for recreation, and the millions then in the State will make their demands for recreation. The use of the forest for this purpose will be vast indeed, not only for summer recreation, but winter sports also will have been highly developed.

At that time the Federal Government will still own the greater portion of the forest lands, and will have combined the National Forest and the National Park systems into one. The National Forests will be serving the purpose of the National Parks in all of the places where such use is desirable. On the other hand, the National Parks, in such of their parts as are less useful for recreation purposes, will be serving other forest uses. The State will own large forests, mainly in the redwood region and Coast Ranges. The counties and municipalities will not be without their publicly owned forests. Private ownership, while greatly decreased, will not entirely have ceased to exist, but the private owner will then be entirely satisfied with an interest rate of 3 per cent on his investment in splendidly managed forest land.

The three main purposes for bringing the forests to this condition will have brought about their great ideal—the highest service to humanity. Civilization will have reached its highest development in California when our great-grandchildren have taken our places, and the forests will play no unimportant part.

At the present time California has a population of 3 million people. Our people are progressive; they have been advancing with rapid strides during the past six years; they are willing to go much farther under the right sort of leadership. High ideals must be placed before them, and they must be helped over the rough places by hard thinking and persevering action on the road to these ideals. The State is now quite highly developed agriculturally in some places, as, for instance, in the citrus country around Riverside and Redlands. The State government is unusually advanced; we are ahead of other States in highway building. In regard to forestry, however, while the people are interested and friendly, they are not fully awake to the needs; they are unorganized; and there is no definite policy upon which to crystallize sentiment and to base action. The National Forests are headed in the right direction; they have real ideals and advancement is being made toward their realization, for there is a unity of purpose among those directing the National Forests. In the National Forest

work the people are somewhat interested, in fact, they are somewhat proud of it, but they take it rather for granted and lack the interest that they would have in work which they were doing more largely on their own initiative.

Outside of the National Forests, the forest lands, with very few exceptions, have not yet taken even the first step in forestry—that of forest protection. A lot of damage is done each year by fire to property, and sometimes even to human life. The private timberlands are subject to a process of timber mining; reproduction is not considered. The owners are uninterested in the fate of the cut-over land excepting ultimately to get the most out of them and let them go, temporarily incurring the expense of carrying them in order to control rights of way, prevent the location of saloons, etc. But we must not blame the private timber owner too much for this attitude, for he is under tremendous pressure to liquidate his investment and get out of the game as soon as he can. He is finding timber a poor investment. He is heavily in debt, and interest charges are oppressive. Taxes are a heavy burden. This, with the mill capacity to produce far more lumber than is needed, with anxiety to produce it, makes for low prices and negligible profits. The industry as a whole is wretchedly organized. It lacks cooperation. It lacks trained men. It lacks research work. On the whole the lumberman is rather bewildered and does not know just what to do to bring his industry to a more stable condition.

Now what do we need to do to bridge the gap between conditions as they now exist in California and conditions as they may exist in 2016 if we only go about the construction of that bridge with sufficient intelligence, enthusiasm, and perseverance? Some of the things that are needed are the reorganization of the lumber industry, research work to ascertain facts and principles and to show how they may be applied, a revision of State laws, a well-organized forestry association, and a forestry publication. The industry is invited to a journey along the road to close cooperation, standardized accounting, sales agencies—domestic and foreign—trade-marked and advertised lumber, association effort, etc., and in addition to help the industry reorganize properly the public must know and understand the difficulties of the industry, and sympathize so far as sympathy is needed. The Government must adjust tax and timber sale policy in an equitable way to the public and to the industry. The Government must extend

its timberland ownership and must cooperate in a friendly way with the industry.

Research work is needed in California to determine the facts about such things as the influence of the forest upon streamflow. For years we have all been talking qualitatively a lot about it, but we make no claims to knowing anything about it quantitatively. If we were in a position to prove absolutely that streamflow conditions would be improved 25 per cent by the best of forest management, the money would be forthcoming surely to do anything that foresters want to do in the State. Research is necessary to determine what forest use can be made and how it may best be made of large areas in the State which are not now well forested. Research is needed in hundreds of industrial problems, from the sort of log which can be profitably removed from the woods to the best method of drying the lumber. Research work at the University is important equally with the teaching work; we wish to prove as valuable to the State through research as through teaching. It is the ambition of the Division of Forestry at the University not only to train the men that are needed in the forest industries, but also to conduct the research work that is necessary to advance the technique of these industries.

Revision of and addition to the laws of the State are needed along several lines. There should be a State Board of Forestry representing the various forest interests. The board should be free from frequent change and especially free from change caused by the political complexion of the State administration. It should be on as high a plane as the board of regents of the University, upon which the members serve for long periods and are free from political control. Ample authority and appropriations should be provided to enable the State forester to institute a real protective system; to provide for paid wardens serving throughout the year, with protection as their main duty, but rendering service along other forestry lines also; to construct improvements needed in connection with forest protection and to buy supplies, to fight fires, to clean up dangerous slash, and to cooperate in protection work with various landowners in the State. Provision should be made for State forests through the acquirement and administration of cut-over and other land valuable for the purpose.

There should be a revision of the tax laws with the object of taxing timberlands in such a way that the process would tend to the conservation rather than the destruction of privately owned timber. It

is believed that taxes are not at present too high with relation to the taxes on other forms of property, nor too high as compared with other States, for California taxes on timber are lower than in any other of the important timber States of the West—not much lower than in the Douglas fir region, but a good deal lower than in the Inland Empire. It is believed that tax reform might well take somewhat the following form: The State forester, upon the request of owners who wish to take advantage of the reform, should classify the land as to its value, if any, for forest uses. In connection with young growth on cut-over lands or resulting from plantations there should be an annual tax of, say, 10 per cent of the value of the net increment on the land. For instance, if 150 board feet is the average annual product, with stumpage worth $2 a thousand, the annual tax under this arrangement would then be 3 cents per acre. There should also be a final yield tax of, say, 10 per cent of the value of the stumpage at the time it is cut. In the case of mature timber there should be a land tax such as used for the young timber, and in addition there should be, it is believed, a yield tax of about 15 per cent of the value of the stumpage when it is cut. This percentage is placed higher than in the case of young timber because man has contributed much less to the value of timber now mature than he will have contributed to the value of timber which he grows from young trees to maturity. In order to adjust the income properly between counties which now are cutting relatively little timber and those which are now cutting a great deal, the State should act as banker, collecting all of the taxes on the classified land and paying over to each county the amount that it received from such land in the year previous to the year of the classification. When the land is cut over it would change automatically from the mature to the young growth class. If the taxes received by the State fail to make up the amount due the counties, as would be the case at the beginning, since with all privately owned land included it is estimated that the collections would amount to about $600,000 out of the present tax of about a million dollars, then the State should make good the difference not by bonding, but through taxes collected currently, making up this loss later on after increased cutting and increased value of stumpage had increased the amount of taxes above a million dollars. The owners of both classes of forest land should be required to protect it and also to apply some rather rough silvicultural methods in connection with cutting to secure reproduction. As one feature of the plan to acquire State forests, taxes on classified

land should be payable to the State in cut-over land, so far as such land fits in with a predetermined plan for State forests, and at a moderate valuation taking into consideration the productive capacity of the land, its forest condition, and its accessibility. Thus the State would take definite steps towards the creation of State forests, and would at the same time tend to solve the cut-over land problem, which is a matter of great concern both to the public and to the private owner.

At the present time the State Tax Commission is considering a revision of the form of taxation of timberland, and timber owners are preparing to present their views on the subject. Nothing has as yet crystallized. It is believed that the revision of the tax system should not be by itself alone, but should rather be a part of a definite forest policy. The timber owners wish a modification of the system which will ease their tax burdens. If they get it they should be willing to fall in with plans for a progressive State forest policy.

In order to crystallize sentiment in the State and to secure results there is needed a State Forestry Association. There are many examples of successful associations and what they can do for the State. For instance, the Southern California Automoible Association has been an exceedingly powerful instrument in connection with the construction of highways, mentioning only one of its activities. It has 84 employees, offices in many of the important towns and cities in the southern part of the State. A few days ago its two-page advertisement appeared in the Saturday Evening Post, inviting the world to come and enjoy southern California's good roads. Such an ambitious association is scarcely practicable for forestry at the start, but there should be such an association to promote the interests of forestry in California.

Finally, here is needed a publication which would be to forestry in the State what American Forestry is to forestry in the United States. Its object should be to bring together the various organizations and people in the State having any interests in forests and forestry, such as the Forest Service, the lumbermen, the State forester, the Division of Forestry at the University, the National Parks, the private foresters, the smaller private forest owners, the clubs which are more or less interested in forests, such as the Sierra Club, the Tamalpais Conservation Club, and many others. The publication should show the people the facts concerning, the needs of, and the remedies for the present forest situation. It should promote the interests of forestry in the State.

COMPUTING VOLUMES IN PERIOD ALLOTMENT

By T. S. Woolsey, Jr., M.F.

New Haven, Conn.

In Europe it is customary to calculate the volumes to be cut after allotment to periods by carrying the yield to the middle of the period. For example in compartment 1 in the interesting illustration given by Schlich,[1] the present age of the stand is 80. The timber is held over two periods of 20 years each and cut during the third period, or at an *average age* of 130 years. To compute the volume to be cut in this case it is merely necessary to multiply the acreage of the compartment by the yield table result for 130 years for the same quality of soil. (In practice this is reduced to the actual per cent of stocking.) Quite a few of the profession in the United States have been accustomed to compute the aggregate stand at 120 years (in the case cited) and then add to this figure half the difference between the yield table figure at the beginning and at the end of the period. This involves two distinct steps, so a longer time is consumed than when figuring simply to the middle of the period. One writer[2] has introduced the innovation of merely computing the volume to the initial year of the period, thus ignoring the growth. While this method is obviously inaccurate, yet in the case cited no harm was done, because unusually short periods had been chosen (10 years each) and the figures, obviously tentative and approximate, aimed at being conservative.

In an interesting article, H. H. Chapman, writing on the "Regulation of Yield on National Forests,"[3] says:

"Then, depending on its acreage and volume, a second arbitrary period for cutting this age class is assigned to it, and *one-half the possible growth or decay* during this period of exploitation is added or subtracted. The possible annual cut is found as before by dividing this final total by the length of the period." (The italics are mine.) Since in the method quoted it has been customary to recognize four age classes or groups (with four periods) it is evident that four periods of no uniform length might vary considerably. With a rotation of, say, 120 years,

[1] Schlich's Manual of Forestry (Fourth Edition), Vol. III, p. 387.

[2] Department of Agriculture Bulletin 234, by D. T. Mason, February 12, 1915. Table 19, p. 37.

[3] Proceedings Society of American Foresters, Vol. VIII, p. 225.

the periods might be: For cutting the veterans, 20 years; mature, 20 years; young merchantable, 40 years; and immature, 40 years. The question now arises: is the usual method of computing the volume of the age class or group to the middle of the period sufficiently accurate? Is it better than figuring the volume to the initial year of the period and adding half the growth (computed by subtracting the yield table figures for the initial period year from that of the last year, or *vice versa*, if the stand is decadent)? Of these two methods, the writer prefers the simpler and shorter "middle of the period" method to the "half the growth" scheme; but for accurate computations with long periods the system that follows is preferable to either.

The new formula[4] merely takes the empirical yield table yield for the middle of each decade of the period and multiplies this figure by the number of decades left in the period divided by the cumulative totals of the number of decades. With a 40-year period the formula would read:

$$\frac{an_4+bn_3+cn_2+dn_1}{n_4+n_3+n_2+n_1}$$

Where a, b, c, d equal the yield at the middle of each decade of the period counting from the initial age of the stand as it enters the period; n_4, n_3, n_2, n_1 the number of decades left in the period including the first decade. To illustrate this simple formula further, reference is made to figure 1.

Figure 1

¼	Cut during 0–10th year of period	*a*
¼	Cut during 11–20th year of period	*b*
¼	Cut during 21–30th year of period	*c*
¼	Cut during 31–40th year of period	*d*

This represents graphically the age class or group which is to be cut over in 40 years. It is evident that if the young merchantable group (to be cut in their period of 40 years), is 80 years old, the first year of the period (if the period starts January 1, and the cutting is in the

[4] When the formula was first drawn up I used the yield table figure at the beginning of each decade so as not to split decade figures, but Chapman called my attention to the inconsistency of not using the middle of the decade figure here, even if it must be obtained by a slight additional computation.

following fall) the average growth at the rate shown in the yield table for the first decade $\left\{\frac{80+90}{2}=85 \text{ years}\right\}$ will take place on the entire acreage, while the rate shown by the yield table at $\left\{\frac{120+130}{2}=125 \text{ years}\right\}$ will take the place on only one-fourth the area since, when the last decade starts, the area will be three-fourths cut over. It is, therefore, logical to weight the yield results as they will apply in practice. This is simply done by the formula. Plot any series of mean annual growths computed from a yield table and the possible disadvantage of using "half the growth," or the "middle of the period" method is evident, because it gives equal weight to the growth at the end of the period with that prevailing at the beginning; or the "middle of the period" yield may not be the average. It incorrectly presupposes that the growth applied to the stock during the period is a straight line. *The error may be large or entirely eliminated according to the regularity and trend of the curve of mean annual growth of the yield table.* The "middle of the period" method is simpler and as accurate as this "half the growth" method, but in theory both are inferior to the weighted yield table formula cited above *when long periods are used.* This weighted formula principle may be applied even more exactly by taking into consideration the exact acreage cut over each decade of the period, and weighted accordingly; such a detailed computation is not necessary.

For the purpose of illustration take the computation of compartment 1 (19 acres) already cited. After shifting to the third period the volume according to the "middle of period" method is 134,710 cubic feet ($7{,}090 \times 19 = 134{,}710$). Had the "half the growth" method been used the result would have equaled 134,330, but a more tedious computation is involved. ($(6{,}840 \times 19) = 129{,}960 + (7{,}300 - 6{,}840 = \frac{460}{2} \times 19) = 134{,}330$.) There can be no question which is the preferred method.

But suppose that periods of unequal length were advisable. We will assume a period of 40 years, yield table as cited,[5] that the timber is 80 years of age at the initial year of the period, and that the timber to be cut over during the period comprises 10,000 acres. The results by

[5] See column G, page 356, Schlich's Manual of Forestry (Fourth Edition), Vol. III.

the (1) weighted yield table method, (2) "middle of period" and (3) half the growth method follow:

(1) *By Weighted Yield Table Formula:*

$$\frac{\left\{\frac{5{,}400+5{,}930\times 4}{2}\right\}+\left\{\frac{5{,}930+6{,}320\times 3}{2}\right\}+\left\{\frac{6{,}320+6{,}590\times 2}{2}\right\}+\left\{\frac{6{,}590+6{,}840\times 1}{2}\right\}}{4+3+2+1}=$$

$$\frac{60{,}000}{10}=6{,}066\times 10{,}000=60{,}660{,}000 \text{ cubic feet}$$

to be cut in a period of 40 years or *1,516,500 cubic feet per year.*

(2) *By Middle of Period Method:*

$$6{,}320\times 10{,}000=63{,}200{,}000 \text{ cubic feet}$$

to be cut in a period of 40 years or *1,580,000 cubic feet per year.*

(3) *By Half the Growth Method:*

$$(5{,}400\times 10{,}000)+\left\{\frac{6{,}840-5{,}400}{2}\times 10{,}000\right\}=61{,}200 \text{ cubic feet}$$

to be cut in a period of 40 years or *1,530,000 cubic feet per year.*

Assuming that (1) is correct then (2) is 63,500 cubic feet too high and (3) only 13,500 in excess. The variations between the methods, however, will have no constant ratio, but must depend on the trend of the yield curve.

It may frequently happen that (2) and (3) will be identical, namely, where the average of the yield (at the initial year of the period and the last year) is identical with the yield at the middle. As a whole the tendency in American forest mathematics is to split hairs, whereas it is essential to realize that the final cut predicted is only an approximation at best. Frequently the computed yield will not be used because reasons of policy or market conditions dictate cutting less or more than the formula or estimated yield. For this reason the writer is cautious about urging the weighted yield table method for computing volumes, except under circumstances where exactness with long periods may be a necessity.

BY-PRODUCT MILLS IN THE HARDWOOD INDUSTRY

By P. L. Buttrick

Consulting Forester, New Haven, Conn.

Following is a brief account of a rather new form of waste utilization which is being developed in hardwood lumber mills. The notes for this article were collected in Virginia, West Virginia, and Kentucky in the winter of 1915.

Among the largest users of hardwood lumber are the furniture manufacturers. Their requirements as to shapes and sizes of materials used are quite different from those of the general construction trade, since they can, to a much larger degree, utilize pieces of small size and irregular dimensions. Examples of stock for furniture are bolts for chair rungs, table legs, etc., usually in the form of short-length pieces with square ends, known in the trade as "squares." Rungs and legs can be turned out of miscellaneous stock on lathes, and short boards can be used for chair seats, backs, table tops, desk panels, etc. These are used solid or for veneer cores or stock, as the case may be. Hitherto they have largely purchased lumber of standard sizes and cut it down to suit their own purposes. Of late, however, certain enterprising hardwood firms have realized the possibility of making much of this small-sized furniture stock out of slabs and edgings, planing-mill ends, etc., and have installed equipment for this purpose generally along with their mills, and furniture firms are beginning to use this material more and more. These mills are variously called "dimension mills," "by-product mills," and the like.

The equipment of a typical plant of this kind in the southern Appalachians and adapted to the needs of a single band mill, cutting from 30 M to 40 M per day, is about as follows: 1 carriage bolter; 1 circular rip saw; 1 gang bolter (Garland); 2 automatic cut-off saws, to which should be added a lath bolter and machine. The floor space covered is about 50 square feet.

Such a plant operated in conjunction with a mill cutting 35 M should be able to produce 3,000 board feet of dimension stock and 5,000 pieces of lath in ten hours.

The machinery for such a mill would cost about $5,000; buildings and drying shed, etc., $1,500 to $2,000 more.

Waste can best be handled as it is to the ordinary lath mill—by arranging for the refuse conveyer to pass through the mill and from it to pick off and sort over the waste which is desired. Planing-mill waste, if used, can be brought in on trucks or by a conveyor, as is convenient.

One disadvantage of this arrangement is that all material must pass through the slasher, and thus often be cut to very poor advantage. To obviate this a special arrangement, adapted to mills not cutting more than 35 M, is in use. The slasher is entirely done away with—in its place is set a table onto which refuse from the slasher is deposited. A jump saw operates across this table. From it lead two conveyors, one to the burner and the other to the by-products factory. Two men operate this saw and are supposed to cut into convenient sizes all waste which is suitable for by-products and slash up the rest, so that it will easily pass through the refuse conveyor to the burner. Trimmer waste passes directly onto the waste conveyors.

When the burner and the by-products mill are situated on the same side of the plant the two conveyors can run through the latter side by side so that any material wrongly classified can easily be transferred from one to the other. A conveyor can carry trimmer waste direct to the by-products mill.

Since two men cannot handle the waste from a mill of more than 35 M, this use of a trim saw, in place of a slasher, cannot be adopted in mills exceeding that capacity, without modifications permitting the use of more than one saw. By lengthening the live rolls from the band mill past the chains running from the edger, a second saw could be added and the use of a slasher thus be dispensed with in large mills.

At the factory, stock is sorted from the lengthwise conveyor. Stock of inferior grade or wood is placed on the lath conveyor. Slabs go to the carriage bolter, short boards or edgings to the rip saw or bolter. The carriage bolter rips slabs into short boards or edgings, as desired; they then go to the rip saw, or the bolter, and finally to the trim saws, after which they are graded and sorted and sent to the yard to season, generally under cover. This seasoning process requires from 60 to 90 days. Material is then ready for shipment to factories, although, if the plant is run in conjunction to a planing mill, short boards may be resawed for veneer or box shook stock or any other product requiring thin pieces.

One very great advantage of this form of waste utilization is that it does not necessarily require planing-mill or dry-kiln equipment,

which are practically essential at sawmills manufacturing box shooks or other manufactured products from their waste. It also has the advantage of enabling the use of a large number of different woods, whereas generally a box factory must confine itself to one or two. Under proper management it should be more profitable than selling waste to pulp or chemical plants, and relatively few mills are situated close enough to plants of this kind to be able to sell to them profitably.

Nearly all of the common hardwoods of the eastern United States have some value when cut into small-sized dimension pieces. A successful hardwood mill man, who has had much experience in the by-product line, declared the value of the common hardwoods to be about in the following order: Oak, yellow poplar, chestnut, beech, birch, and maple. Basswood, cucumber (Magnolia), etc., are occasionally run in with poplar, as they are in straight lumber manufacturing. Other species, such as black and red gum, black walnut, ash, cherry, cottonwood, etc., could doubtless be used where they are sufficiently plentiful, as could be certain of the softwoods, notably white pine. As a matter of practice, such scattering softwoods as are cut on the average hardwood operation are generally turned into lath rather than chair or furniture stock. Nearly any size stock below that of standard lumber can be made at such plants, but in such as have been visited by the writer it is the general policy to concentrate manufacturing on certain sized pieces, generally with dimensions in whole or half inches.

At a certain plant the following cutting sizes are regarded as standard: 1″x 1″ to 3″x 3″, lengths 12½″ to 60″. One-inch squares are regarded as the least profitable class of stock, although, of course, the easiest to obtain. Oak, 3″x 3″, used for table legs is said to be the most desirable stock.

The operating costs of by-products (not including lath) of such a plant as described are about as follows:

	M feet b. m.
Manufacture	$10.00
Piling and seasoning	2.00
Loading	.50
Supplies	1.00
	$13.50

The success of such a plant, when run in conjunction with the average hardwood mill, will depend to a considerable measure upon its proximity to markets and its selling connections. The future will probably see a greater extension of the idea.

DETERMINING THE QUALITY OF STANDING TIMBER

By Swift Berry

Forest Examiner, Forest Service

The quality of the stand, as measured by the grades of lumber it will produce, is one of the most important factors entering into the appraisal of the stumpage value of a timber tract. In appraisals of National Forest timber the stumpage value is considered to be the difference between the estimated average selling price and the sum of the estimated cost of production and the assumed margin of profit. Since the average selling price per thousand for each species depends upon the proportion of the grades in the product, a mistake in estimating the quality of the stand may more seriously affect the accuracy of an appraisal than any possible error in calculating the operating cost. Thus there is plainly need for exact and uniform methods of determining the quality of stands involved in stumpage appraisals. In this connection, the method now used in District 5 may be of interest.

The first action in obtaining material for use in estimating the grades that may be produced from logs or standing timber is the making of mill-scale studies to record the grades actually cut from the various species in different localities. In order to facilitate the arrangement of the data resulting from this work, tentative log grades were established and rules prepared outlining the specifications of these grades. Three grades were made for both sugar and yellow pine, each being based upon the prevailing lumber grades in the logs within it. Thus grade I logs cut largely to clear lumber, grade II logs to shop lumber, and grade III logs to common and box lumber. Douglas fir was also given three log grades, but only two were made for white fir and incense cedar.

In carrying on the mill-scale studies, the logs are scaled and graded and a record kept of the amount and grades of lumber sawed from each log. At the end of the study the results for each species are compiled into tables, showing the average amounts and per cents of lumber by grades sawed from logs of each inch diameter class under each log grade. The per cents are then adjusted by curving into tables for field use. An example of such a table is given here as Table 1:

TABLE 1.—*Yellow Pine. Grades from Sound Grade I Logs*

Diam. Class	*1 and 2 Clear*	*3 Clear*	*C Select*	*Austra-lian*	*1 Shop*	*2 Shop*	*3 Shop*	*1 and 2 Com-mon*	*Box*
Inches	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
26	26	9	.	2	16	16	3	27	1
27	26	9	.	2	17	16	3	26	1
28	26	9	.	2	17	16	3	25	2
29	26	9	1	2	17	16	2	25	2
30	26	9	1	2	18	15	2	24	3
31	27	9	1	2	18	15	2	23	3
32	27	10	1	2	18	15	2	22	3

In addition, these mill-scale studies give the amount the lumber tally overruns the log scale for logs of different diameters and grades. The average overrun for logs of each diameter class is shown in the tables summarizing the results of the mill-scale studies. When curved for each log grade, overrun tables should have about the following form:

TABLE 2.—*Yellow Pine. Overrun from Sound Grade I Logs*

Diam. Class Inches	*Per cent overrun*	*Diam. Class Inches*	*Per cent overrun*
26	4	30	3
27	3	31	4
28	3	32	4
29	3	33	5

One thing more is needed to facilitate the application of this mill-tally data to standing timber. This is a taper table, showing the average top diameters of the various logs in trees of different diameters and heights. This table is preferably based upon diameters breast-high from 12 inches up and upon the number of 16-foot logs. It is planned to prepare such tables for universal use in District 5 from the volume table measurements already taken. A separate table is, of course, required for each species. A portion of a table of this character is given in Table 3:

TABLE 3.—*Yellow Pine. Taper Table*

Tree diameter breast-high		*D.i.b. at top end*								
	No.	1	2	3	4	5	6	7	8	9
Inches	*Logs*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
32	6	25	23	20	18	15	11	..	..	..
32	7	26	24	22	19	16	13	10	..	..
34	6	28	25	22	19	16	11	..	..	..
34	7	28	26	24	21	18	14	10	..	..
36	7	30	28	25	22	18	14	10	..	..
38	7	31	28	25	22	18	14	10	..	..
38	8	32	30	28	25	22	18	14	10	..

Equipped with these tables, the appraiser is ready for the field work. After a general idea of the tract is obtained, sample strips should be located which are representative of the timber. If more than one stand type occurs, the sample areas should be located by such types and the results computed for each type separately. Afterward the results may be combined into a whole for the tract upon the basis of the volume of the stand in each type. Probably the most accurate way of locating the sample areas is by means of strips, one or two chains wide, which are run at right angles to the slopes, much as is done in reconnaissance. All trees which are to be cut upon the strip are recorded. The work may thus be done to advantage in connection with sample marking. In recording a tree the first step is to measure the diameter breast-high; the second is to estimate the number of logs. By reference to the taper table the top diameter of each log is ascertained. Then the butt log is graded according to its conformance with the tentative log grading rules, as judged by its outside appearance. Next, the second log is so graded, and the operation continued for each log in the tree. A notebook is provided, in which the diameter and grade of each log are recorded. A practicable form for this notebook record is shown by the two left-hand columns of Table 4.

The computation of the proportion of grades from this field record is simple, although it involves considerable work. The first step is to calculate the log scale feet board measure for each diameter class under each grade; separately for each species. This is readily done by applying the decimal C scale rule. Next the overrun must be taken into consideration, which may be done by calculating the overrun in the log scale for each diameter class from the data given in the overrun table (Table 2). The information at hand would then be in somewhat the same form as Table 4:

Table 4.—*Grade I Yellow Pine* (*Sound*)

Diam. Class Inches	*Number Logs*	*Log Scale Ft. b.m.*	*Log scale plus overrun Ft. b.m.*
26	. — 1	500	520
27	.. — 3	1650	1700
28	.. — 2	1160	1195
29	.. — 3	1830	1885
30	.. — 4	2640	2719
31	.. — 3	2130	2215

The table showing per cents of grades from logs of various sizes

(Table 1) is next consulted, and the log scale (increased by overrun) for each diameter class is divided into the various grades of lumber which it may be expected to produce. Thus, for example, the total of 520 feet b. m. for 26-inch grade I yellow pine logs will be divided as follows: Nos. 1 and 2 clear 26 per cent, or 135 feet; 3 clear 9 per cent, or 47 feet; Australian, 2 per cent, or 10 feet; No. 1 shop, 16 per cent, or 83 feet; No. 2 shop, 16 per cent, or 83 feet; No. 3 shop, 3 per cent, or 16 feet; Nos. 1 and 2 common, 27 per cent, or 141 feet, and box, 1 per cent, or 5 feet. After this step has been completed for all three grades, the amounts of each lumber grade are added for each species. From these sums the per cents of each lumber grade are obtained, and after applying the effects of lumber depreciation the appraiser is ready to calculate the average selling price. The results of computing the data in the preceding table are given in Table 5 as an example of the form the information should take in the appraisal report.

TABLE 5

Species	1 *and* 2 *Clear Per cent*	3 *Clear Per cent*	*C Select Per cent*	*Australian Per cent*	1 *Shop Per cent*	2 *Shop Per cent*	3 *Shop Per cent*	1 *and* 2 *Com. Per cent*	*Box Per cent*
Yellow pine...	26.1	9	0.7	2	17.4	15.5	2.3	24.7	2.3

Absolute accuracy is not claimed for this method. However, it is without question far ahead of former methods of guessing at the quality of stands or of estimating by comparison with the grades produced by various mills. Furthermore, it should give accurate results as to the relative quality of two or more stands, which is one of the main points we are after. Care is necessary in applying the method to insure accurate estimation of the number of logs in a tree and the proper grading of each log. There is frequently a tendency to grade logs in standing timber higher than they really are. This is especially true of No. III logs of large diameter. Anyone using this method should be thoroughly familiar with the log grade specifications, and also preferably have followed logs of the various grades through a sawmill.

THE SPREAD OF TIMBERED AREAS IN CENTRAL TEXAS

By J. H. Foster

State Forester of Texas

Lying in the south-central part of Texas is a region known as the Edwards Plateau. This is a deeply eroded, limestone country forming the southern extension of the Great Plains and terminating abruptly on the south and east in an escarpment 400 to 1,000 feet in elevation, known as the Balcones Escarpment. South of this escarpment lies the Rio Grande Plain and east of it are the great agricultural prairie belts of east-central Texas. Northward extending to the Red River, and northwestward to the Breaks of the Plains is a vast territory consisting of carboniferous and red beds deposits and granitic areas which may be termed the central denuded region of north-central Texas. The Edwards Plateau proper consists of limestones of the older cretaceous formation, faulted and uplifted during tertiary time and since then eroded into hills and narrow canyons with stretches of rolling prairie between. The area of greatest erosion and dissection is toward the eastern and southern escarpments, the region farther west gradually flattening out until it merges into the Great Plains. Erosion has also played an important part in the transformation of the denuded region, causing steep bluffs and isolated buttes, deep gorges and long, even slopes often covered with broken rock strata.

The Edwards Plateau and the surrounding regions have during recent years been undergoing a remarkable transformation from grasslands and exposed rock formations to a forested condition. This is the more remarkable when it is realized that the average rainfall does not exceed 25 inches per year and that it is a region of little humidity, intense sunlight, and rapid evaporation. Such conditions are conducive to grassland vegetation. It is not fair to assume that this region has hitherto been treeless, but throughout central Texas as a whole forest growth has been confined to the more eastern slopes of the Edwards Plateau and to the canyons, stream borders and occasional steep bluffs and mesa tops in the regions northward. The present forests consist of three principal classes: along streams and canyons, on hills and bluffs, and prairie growth.

The Edwards Plateau is a common meeting ground for species from the Atlantic forest belt, the southern Rocky Mountains and the north Mexican highlands. Ninety species of trees and shrubs have been identified. Many of the species found along the streams which flow through the Edwards Plateau, or which flow from springs along the eastern escarpment, are those of the Atlantic flora—extensions of the eastern bottomland type. One is amazed to find within these canyon bottoms bald cypress of the southern swamps growing several feet in diameter. There is evidence that considerable quantities of cypress existed along the eastern escarpment at the time of the early settlements. Many of the oldest buildings in San Antonio and other cities and towns adjacent to the hill country were constructed of this species and some are standing today. American elm, sycamore, pecan, live oak, overcup, Texas red and burr oaks, cottonwood, hackberry, and walnut are among the most important Atlantic species in this canyon type. One occasionally finds burr oak five feet in diameter and live oak and pecan nearly as large. These forests are not of recent origin and in the early days the type probably did not differ materially from that which exists today.

Forest areas have long existed to a limited extent on rough slopes and hillsides, breaks of streams and summits of plateaus and mesas, generally where erosion has been severe, but where the rock debris was not so unstable as to prevent capture by woody growth. Among the species of trees found in these original types the most important are mountain cedar *(Juniperus sabinoides)*, mountain oak (a form of *Quescus texana)*, live oak, mesquite, cedar elm, hackberry, and shin oak *(Quercus undulata)*. These occur either in mixed stands of open growth or in pure stands, such as cedar brakes and oak thickets, over limited areas. The cedar brakes consist of dense stands of mountain cedar, generally short and scrubby, growing on dry, crumbly limestone soils. They are of decided commercial importance and for ten miles or more back from transportation points are cut for posts and poles and shipped to all parts of central and west Texas. Cedar cutting has been going on for many years and since the brakes are usually not cut clean, they tend to renew themselves, except where fires burn through the brakes, and even then a return to cedar is not unusual. Fires, however, are a serious obstacle to cedar reproduction and fortunately there is a strong sentiment against burning. Mountain oak thickets are common on the sides of gorges and on the

summits of flat-topped mesas, where the trees often grow to fair size. Still another type of oak thicket is the so-called "shinnery" of scrub shin oak often covering the low divides and now rapidly spreading over grassland areas.

A remarkable transformation of grasslands into forest areas is now taking place from isolated patches of original woodland on rough lands to the rolling uplands in general and across intervening prairies. Capture by tree growth is still more remarkable in sections far removed from forest belts as in the western portion of the Edwards Plateau, the denuded region and elsewhere. It is safe to say that fully 50 per cent of the grassy uplands of the Edwards Plateau is now occupied by some form of woody growth. The mountain cedar is not only maintaining itself, but is spreading to new areas on steep slopes where no other species except perhaps sumac has succeeded in gaining a foothold. Sumac *(Rhus virens)* seems to be a forerunner to the spread of cedar and other important trees; at least under certain conditions where its seed germinates and furnishes temporary protection to other species which follow. Mountain oak thickets are spreading downward from the ridges and mesa tops. Gradations in age of trees from the oldest on mesa or ridge tops to the youngest marking the lower limit of tree growth can be seen in many points of central Texas. The shinneries now occupy many square miles in compact areas, crowding out the grass over low divides and on uplands where the grass cover was formerly complete. An open stand of mixed cedar, mesquite, mountain oak, and live oak, with a ground cover of prickly pear, occupies vast areas of rolling upland which, within the memory of men now living in the region, was covered only with grass. Within the last 25 or 30 years the change has been so marked as to become a matter of common discussion and of considerable apprehension on the part of stockmen. Every old resident can point out thickets of oak, mesquite areas or scattered cedars, live oak, and mesquite growing on his ranch which in the years gone by did not exist.

The invasion of mesquite and other tree growth on level prairie stretches in the regions surrounding the Edwards Plateau is a matter of equal interest and importance. Mesquite has not only spread over the entire Rio Grande Plain, and to a lesser extent over the Edwards Plateau and the level lands of the denuded region north of it, but has become a marked feature of the Black and Grand Prairies of east-central Texas, and is actually invading portions of the lignitic belt of

northeastern Texas. It is found in the Breaks of the Plains, but has gained no foothold on the high, level plains themselves, apparently being killed back by frosts. Its growth throughout central and south Texas is habitually orchard-like, but after a time other species appear to enter into the stand. Sufficient time has not yet elapsed for any of the species invading new territory to attain large dimensions. Wide as is the distribution of mesquite, it is of timber size only in some of the Rio Grande sections invaded many years ago. In the western portions of the Edwards Plateau live oak is an abundant tree and its shrub-like form is due not entirely to lack of adequate rainfall but partly to its recent establishment.

The causes which have resulted in the spread of timbered areas are traceable directly to the interference of man. Before the white man established his ranch home in these hills the Indians burned over the country repeatedly and thus prevented any extension of forest areas. With the settlement of the country grazing became the only important industry. Large ranches in time were divided into smaller ranches and farms with a consequent fencing of ranges and pastures. Overgrazing has greatly reduced the density of grass vegetation. The practice of burning has during recent years disappeared. The few fires which start are usually caused by carelessness, and with alternating wooded and open spaces and the close-cropped grass, they burn only small areas. These conditions have operated to bring about a rapid extension of woody growth. Almost unquestionably the spread of timbered areas received its impetus with the gradual disappearance of grassland fires and has been hastened by the reduction of the grass cover itself.

The spread of timber over the pasture lands of central Texas cannot be viewed without some misgiving, since grazing lands are being reduced in area. On the other hand, the supremacy of grass vegetation will not for many years be destroyed and many distinct benefits from the forest cover are recognized. Among these are the benefit of partial shade for stock, greater abundance of fuel wood, fence posts, and other material for farm and ranch homes, and protection to the soils and water supply. Perhaps of all these the influence of an increasing percentage of forest cover on soil and water distribution will in the long run be the most important.

REPRODUCTION OF BLACK SPRUCE *(PICEA MARIANA)*

By W. H. Kenety

Superintendent Forest Experiment Station, Cloquet, Minn.

One of the trees which is economically very important in Minnesota, Wisconsin, and Canada is the black spruce *(Picea mariana)*. This tree up to the present time has been the source of the greater part of the paper pulp manufactured into news paper in these states and parts of Canada.

It is doubtless generally known that black spruce is confined almost entirely to sites, the vegetative ground cover of which is moss, known under the terms of sphagnum moss, peat moss, etc., and composed largely of species of Lycopodium.

Black spruce is found as a dominant type on two sites which are very different in some respects, one being the spruce swamps and muskegs of Minnesota, Wisconsin, and adjacent parts of Canada, and the other the rocky outcrops of rock, so prevalent in northeastern Minnesota. In a study of black spruce the writer's attention was attracted by the similarity of the type of vegetation and the very dissimilar topographic and soil features of these two situations. Both sites where black spruce prevailed had a cover of moss, and this feature was so pronounced that a sort of symbiotic relationship between the moss and the spruce was suggested. A study was made of the ecological conditions in a spruce swamp where data were secured daily throughout one growing season, from June 1 to November 1. Soil temperatures taken throughout the season at depths of 6 inches, 12 inches, and 24 inches revealed the fact that the temperature of the first foot of soil did not get above 32° F. until the first week of June. Ice was found in many places in the swamp within a foot of the surface until the middle of July. The mean temperature of the soil from June 1 to November 1 was 46.1°. The soil was warmest in September and the upper 6 inches rarely reached a temperature of 50°. Determination of the soil moisture based on the dry weight of the soil showed that throughout the season the soil was nearly saturated, no determination giving less than 80 per cent moisture. Under these trying conditions it can be easily understood that the germination and establishment of any spruce seed in this sort of a situation is almost an impossibility. This is substantiated by the fact that no

seedling spruce could be found in the swamp. Seedling spruce were quite plentiful on the edge of the swamp where the seed fell on mineral soil.

The next step in the study of the spruce habitat was to dig down to mineral soil and find out the depth of the peat, the differences in its composition at the different depths, and the nature of the root system of the spruce. The pea was found in this instance to be 8 feet deep and underlaid with sand. The roots of the spruce were very superficial and did not extend below the surface more than 2 feet. The soil or peat samples were examined at intervals of 6 inches. This particular swamp supported a stand of 550 spruce trees to the acre, averaging 6 inches d. b. h. and 60 feet tall. The samples taken consecutively from the mineral soil to the top of the moss showed a transition from a grass peat in the lower samples, to a peat composed of grass and shrubs in the next section above, and to a peat almost wholly composed of sphagnum moss in the upper 4 feet. Intermingled in the samples of the upper two-thirds of the peat were found well-preserved branches of shrubs and black spruce. These layers of peat show the stages of succession which have taken place from the time the open pond filled up with grass to the present forest type characterized primarily by black spruce. A contemporaneous study of the formation of muskegs from the different stages present in northern Minnesota, which space will not permit a discussion of, substantiated the record of succession preserved in the peat. In many regions of Minnesota may be found today, in close proximity to each other, swamps in which every stage from the open water to the ultimate forest are present.

To get back more pointedly to the subject at hand, the foregoing has been stated to bring out the fact that black spruce is the ultimate or dominant type in the muskeg formations, and in the swamps studied no seedling reproduction could be found on the floor of moss. The reasons for the lack of seedlings may be briefly summarized—the soil was nearly always saturated, the temperature was below the germination point except at a few times in the latter part of the season, any seed which might possibly germinate would make little growth the first year, due to the lack of mineral soil and lack of adequate sunlight and unfavorable temperature. On the other hand the moss surrounding any seedling piles up its loose uncompacted layers at the rate of several inches a year. As a consequence any young seedling would

be smothered. Even four-year-old transplants which were planted as an experiment to determine the feasibility of reforesting these swamps were smothered out by the moss in many instances.

How then does the black spruce perpetuate itself in these muskeg and spruce swamps and maintain itself as the dominant and controlling species? The writer discovered in 1910 that black spruce perpetuates itself in these swamps by layering. This vegetative system of layering is quite rare in conifers and is a striking example of the law of perpetuation. In the formation of the peat swamps the spruce gradually migrated from the outer edge inward as the moss took the place of grass and sedges. The lower branches of the spruce were covered by the rising moss, and these branches in the water-laden substratum produced adventitious roots which with the help of the food derived from the parent tree stimulated the growth of the branch. The end of the branch assumed an upright position, while the roots on the branch became more extensive. Finally the connection with the parent tree became severed or the old tree died and an independent tree was formed. The lower branches of this tree go through the same cycle and in this way migration and establishment of the species is carried on.

In many cases when the moss was dug away the old branch connection for four generations was still linked together under the peat. The sapwood in all cases had decayed and only a part of the heartwood was left. In some cases severed branches were found which had rooted, and many instances were found where the branches of a prostrate tree which had been partly buried in the moss were growing and had developed roots, while the stem or bole of the windthrown tree was dead.

On the moss-covered rock of northeastern Minnesota, where black spruce is found and to which reference was made in the first part of this paper, the same method of reproduction has been found.

Whether or not it is possible to artificially reproduce black spruce vegetatively, our experiments are not yet conclusive.

A DECIMAL CLASSIFICATION FOR FORESTRY LITERATURE

By Clarence F. Korstian

In Charge of Research, Forest Service, Ogden, Utah

The need of a systematic and comprehensive scheme for the classification of forestry data and literature has been apparent for some time at various experiment stations and district headquarters of the U. S. Forest Service. At present, if all of the available information on any special subject is desired, a diligent search much be made through the files and a great many books, bulletins, and circulars in the library must be consulted. But if an adequate compilation system were in effect, either a direct excerpt of the information desired or a reference to its exact location could easily be found in a short time. With a view toward eliminating the useless expenditure of energy and time and converting a chaotic mass of knowledge into a classified and systematized arrangement, the following classification for forestry is suggested.

Two general classification schemes[1] have been proposed, but both are inadequate to meet the needs of intensive specialization. A tentative outline was prepared early in 1915 after making a careful study of all available source material. The preliminary draft was a modification and expansion of the above-mentioned schemes and the filing schemes used in the various branches and offices of the U. S. Forest Service. The report of the committee of the conference of forest schools on standardization of instruction in forestry[2] was also consulted in determining the proper correlation of the various branches. The scheme was submitted to a number of prominent professional foresters and librarians, to whom the writer desires to make acknowledgment for the many valuable suggestions and assistance rendered by them. It is hoped that this classification may be improved through systematic use as further advancement is made in the science.

Since forestry is a natural science, the subject should be placed

[1] A Classification for Forestry Literature. Yale Forest School, Bulletin 1, 1912. Detwiler, S. B., Teaching Students to Conserve Energy. Forestry Quarterly, 10, 402–406, 1912.

[2] Forestry Quarterly, 10, 341–394, 1912.

on a firm scientific basis, and all further development should also be based on scientific methods. Science is an exact and systematic statement of knowledge concerning some subject or group of subjects. The fundamentals of science, then, are exactness and system, both in research and in the arrangement and dissemination of knowledge. Any systematic scheme of classification, to be highly utilitarian, must be simple and yet comprehensive, practical in its application, capable of further expansion as the demands upon it increase, and sufficiently broad to cover the entire field of the profession. A scheme, to be entirely comprehensive, must provide for all possible contigencies which may arise in the future. Any compilation or classification system should render information more accessible.

Although no one forester may ever have use for the complete outline, it is felt that it should be useful to the profession as a whole. The major subjects are given a detailed expansion which, it is hoped, will be commensurate with the needs of the specialist. The decimal system of classification has been preserved throughout. The field of forestry was divided into nine component parts of approximately equal importance. All subdivisions also were, perforce, limited to nine. This limitation, however, is no serious defect of the scheme and was remedied by choosing broad, comprehensive major captions, and in some cases by further amplifying the secondary subjects. While practical utility and economy are the potent characteristics of the decimal system of classification, yet logic is of considerable importance, since those who will use the scheme must know at least the main branches, which are more easily remembered if they are logically chosen. Likewise the writer was mindful of the principles of library science and endeavored to formulate the scheme accordingly. This system is equally applicable to the indexing and classifying of books and pamphlets on the shelves of a library, cards in a catalogue, clippings and notes in almost any form, and, in short, material in any form which may be desired at some future date.

Dewey[3] claims the following advantages for the decimal system of classification compared with any other system based on letters, symbols, numbers, or any combination of them:

1. Less expensive.
2. More easily understood, remembered, and used.

---

[3] Dewey, Melvil, Decimal Classification and Relative Index, 795 pp, 1913.

3. Practical rather than theoretical.
4. Brief and familiar in its nomenclature.
5. Capable of (almost) unlimited expansion, admirably adapted to the needs of the student or specialist.

It is considered desirable to make the proposed scheme for forestry form a part of the widely used Dewey decimal classification because of greater consistency and expediency when auxiliary subjects are considered. It is hoped that this may be done without too great a sacrifice of the logical coordination of the subject matter of forestry. It is very essential that at least the major portion of any scheme proposed for the use of professional foresters be logically coordinated. In drafting a classification of any subject the author should be ever mindful of where a user would naturally look first for the material. Dewey, in his decimal system of classification, places forestry subordinate to horticulture. Forestry should at least be coordinate with horticulture and only through an enforced definition can forestry be made subordinate to agriculture. This position is fully justified when one considers the great advancement which has been made, and the great mass of literature which is rapidly accumulating in the science of forestry. However, the integral number to the left of the decimal has been omitted in the proposed scheme in order that it may be more easily adapted to any library system.

This scheme is intended to serve a dual purpose, not only for compilation, either as a general or a more specialized outline, which will be its greatest utility, but also as a cataloging scheme. By making the scheme sufficiently detailed to adequately meet the needs of intensive specialization in any branch of the subject, it should be applicable to the requirements of practically every member of the profession. The specialist can go through the scheme and merely choose the captions which he will have occasion to use and disregard the others, without serious difficulty or confusion. This will permit each to use minute subdivisions where desired or needed without being forced into refinements in subjects on which they have a small amount of material or little interest.

As stated above, the scheme is also adapted to the cataloging of libraries by subjects. The detail desired in any library catalog can be regulated by going through the outline and selecting those headings which it is desired to use. The Cutter system of individual author numbers is, of course, to be used in conjunction with the decimal

system of classification in cataloging. It may be desirable to also have an author and a title catalog; but in compilation the classification of knowledge by subjects is by far the most important. The object sought in the compilation of forestry knowledge is to secure a direct reference to all material of permanent value to the profession pertaining to a given subject. As each topic and subtopic bears a designating number, the exact location of any material in the compilation file is shown by placing the proper number near the upper left-hand corner of the page. In applying the outline in its most expanded form, the most specific heading applicable to any given material is used. General material under a given topic to which all of the subtopics are inapplicable will bear the designation of the main topic only. The guide cards and folders in the vertical compilation file will bear both their designating numbers and subjects. By using a combined decimal and subject classification for the compilation file the card catalog is believed unnecessary and may be omitted.

The regular Dewey decimal system of classification, with perhaps a few minor changes, is suggested for use in classifying all auxiliary subjects which have a fundamental relation to any of the various branches of forestry. In the classification of forestry material, that part of the number to the left of the decimal may be omitted or replaced by a letter symbol and merely that part to the right used, as is shown in the following scheme; but it will be necessary to use the complete numbers of the auxiliary subjects, which is also desirable in order to show their relation to the universe of knowledge.

It seems very desirable for the profession as a whole to standardize and adopt a uniform system of classification, to the numbers of which more significance can be attached. It is freely admitted that it is rather difficult to secure agreement within the profession relative to the proper expansion as well as the logical arrangement of the subject matter. In this connection, it is interesting to note that the chief criticism of some was that the tentative outline was not sufficiently expanded, while others contended that it was too detailed. However, this is no serious disagreement, since those desiring a more general scheme can use the detailed outline by merely selecting such of the major captions as are desired. Now that our forestry terminology has been standardized by a committee of the Society of American Foresters, could not the same society do an excellent service to the

profession by taking the necessary action leading to the adoption of a standardized and uniform system of classification for forestry?

CLASSIFICATION OF FORESTRY

.0	**General forestry.** (Material covering entire subject or several branches not classified elsewhere.)
.01	Bibliographies.
.02	Manuals of forestry, general treatises, essays, addresses, documents, etc.
.03	Dictionaries, encyclopedias, yearbooks, almanacs, calendars, etc.
.04	Biographies
.05	Forestry periodicals, lumber and trade journals.
.06	Proceedings and reports of societies, associations, commissions, conventions, federal, state, and municipal forest officers, etc.
.07	Forest education. (See also .9713 and .9724.)
.071	Forest schools.
.072	Arbor day.
.073	Nature study and general propaganda.
.08	Forest experiment stations.
.09	History and status of forestry.
.091	United States (alphabetically by states). (See also .941, .971, .972, .973, and .974.)
.092	Foreign countries (alphabetically by countries). (See also .942 and .975.)
.1	**Forest botany. Forest biology.**
.11	Anatomy and morphology (including cytology and histology).
.12	Physiology (including phenology).
.13	Taxonomy.
.14	Silvics. Forest ecology. Biological dendrology. (For acclimatization and tree introduction see .257.)
.141	Ecological factors.
.1411	Climatic. Atmospheric.
.1412	Solar. Ethereal.
.1413	Edaphic. Soils.
.1414	Biotic. Animals.
.142	Reproductive power.
.1421	Seed production (including age of bearing, amount, periodicity, time of ripening, fall fertility, and losses).
.1422	Ability to reproduce by sprouts.
.1423	Ability to reproduce by cuttings.
.143	Tolerance.
.144	Growth.
.145	Resistance to adverse conditions and recuperative ability.
.146	Forest types and site qualities. Forest geography.
.1461	Determining criteria.
.1462	Origin.
.1463	Development.

.1464 Characteristics.
.1465 Succession.
.147 Studies of species (alphabetically by species to provide for assemblage of all data pertaining to a particular species).
.1471 Botanical characteristics. (See also .11, .12, and .13.)
.1472 Range and character of distribution.
.1473 Associated species.
.1474 Silvical characteristics.
.14741 Soil requirements. (See also .1413.)
.14742 Moisture requirements.
.14743 Light requirements. (See also .143.)
.14744 Climatic requirements. (See also .1411.)
.14745 Reproduction and seedling development. (See also .142.)
.14746 Form and volume.
.14747 Growth.
.14748 Yield.
.14749 Susceptibility to injury. (See also .3.)
.1475 Characteristics of the wood. (See also .51.)
.1476 Utilization and economic importance. (See also .4 and .9.)
.1477 Propagation and planting. (See also .25.)
.1478 Management. (See also .2, .72, and .73.)
.15 Arboreta (lists of native and exotic species).
.16 Forest description.
.161 United States (alphabetically by states). (See also .941.)
.162 Foreign countries (alphabetically by countries). (See also .942.)
.2 **Silviculture.**
.21 Preliminary and intermediate cuttings.
.211 Improvement cuttings.
.212 Cleanings.
.213 Liberation cuttings.
.214 Thinnings.
.215 Damage cuttings.
.216 Pruning.
.22 Final cuttings. Silvicultural systems.
.221 Selection system (including modified application in groups).
.222 Shelterwood system (in its various forms of application).
.223 Clear cutting with artificial regeneration.
.224 Clear cutting with natural reproduction (including seed tree methods).
.225 Coppice.
.226 Coppice with standards.
.23 Marking.
.24 Brush disposal.
.241 Piling.
.242 Top lopping and scattering.
.243 Top pulling.
.244 Burning.

.25	Forestation.
.251	Seed. (For antaomical and morphological, and physiological data see .11 and .12, respectively.)
.2511	Source of seed.
.2512	Collection.
.2513	Extracting and cleaning.
.2514	Testing.
.2515	Storage.
.252	Nursery practice.
.2521	Prelinimary treatment of seed.
.2522	Sowing.
.2523	Fertilizing.
.2524	Shading.
.2525	Watering.
.2526	Protection from frost and winter-killing.
.2527	Root development.
.2528	Transplanting.
.2529	Retarding spring growth.
.253	Planting and seeding. (For control of shifting sands see .358.)
.2531	Kinds and classes of plant material.
.2532	Methods.
.2533	Effect of cover.
.2534	Planting and seeding sites.
.2535	Care of plantations.
.2536	For investment.
.2537	For windbreaks and shelterbelts.
.2538	For watershed protection. (See also .97112.)
.2539	Shade and ornamental trees, hedges, willow holts, etc.
.254	Costs and cost keeping.
.255	Tools and equipment.
.256	Underplanting.
.257	Introduction of exotics. (See also .26.)
.258	Extension of range of native species.
.259	Tree breeding.
.26	Farm and woodlot forestry.
.3	**Forest protection.**
.31	Fire. (See also .961.)
.32	Diseases.
.33	Insects.
.34	Animals.
.341	Grazing animals. (See also .85.)
.342	Rodents.
.343	Birds.
.35	Climatic injuries.
.351	Wind.
.352	Snow.
.353	Hail.
.354	Frost.

.355 Lightning.
.356 Sun-scald.
.357 Floods.
.358 Erosion (including shifting sand).
.359 Avalanches.
.36 Mechanical injuries.
.361 Logging.
.362 Guy wires, climbers, etc.
.363 Electricity.
.37 Chemical injuries.
.371 Gases and smelter fumes.
.372 Smoke.
.38 Trespass.
.4 **Forest utilization and lumbering.** (For utilization by species see .1477.)
.41 Logging. Logging engineering.
.411 Felling, limbing, and bucking. Log making. (For brush disposal see .24.)
.412 Transporting logs to skidway, landing, or mill.
.4121 Short distance transportation.
.41211 Power skidding and aerial tramways.
.41212 Animal snaking, bunching, and skidding.
.41213 Wheeling.
.4122 Long distance transportation.
.41221 Logging railroads.
.41222 Log driving and rafting.
.41223 Trucking.
.41224 Sled hauling.
.41225 Timber slides and chutes.
.41226 Flumes and log sluices.
.413 Logging equipment and depreciation.
.414 Logging administration.
.42 Lumber manufacture.
.421 Pond to chains.
.4211 Log ponds.
.4212 Sawing.
.4213 Resawing.
.4214 Edging.
.4215 Trimming.
.4216 Conveyor system.
.4217 Power and transmission.
.422 Chains to yards.
.4221 Dry sheds. (See also .521.)
.4222 Dry kilns. (See also .522.)
.4223 Piling and stacking.
.423 Lumber, log, and timber grades and grading rules. Specifications for timber products. (See also .712.)
.424 Remanufacture of lumber.
.425 Loading on cars.

.426 Utilization of low-grade material. Milling by-products.
.4261 Lath.
.4262 Shingles. (See also .437.)
.4263 Staves. (See also .433.)
.4264 Sawdust.
.427 Disposal of waste.
.428 Manufacturing equipment and depreciation.
.429 Manufacturing administration.
.43 Wood-using industries. Uses of woods. (For individual species see .1476.)
.431 Pulpwood and paper.
.432 Box and crate.
.433 Cooperage. (See also .4263.)
.434 Furniture, vehicles, and implements.
.435 Railroads.
.436 Wood distillation. (See also .514.)
.437 Shingle. (See also .4262.)
.438 Mining.
.439 Miscellaneous (alphabetically by industries.)
.44 Forest by-products.
.441 Naval stores. Turpentine orcharding.
.4411 Distillation of crude turpentine. (See also .514.)
.4412 Methods and costs.
.4413 Possibilities of various species.
.4414 Effect on timber.
.4415 Markets.
.442 Tan bark. Tannin. (See also .514.)
.443 Fuel wood. (For fuel value of wood see .514.)
.444 Maple sugar. (See also .514.)
.445 Cork.
.446 Rubber. (See also .514.)
.447 Gums, resins, extracts, and oils. (See also .514.)
.45 Merchandizing or marketing of products.
.451 Methods of selling.
.452 Transporting products to consumer. Freight rates.
.453 Markets.
.454 Weights of lumber.
.46 Lumbering accounting.
.461 Logging costs.
.462 Milling costs.
.463 Selling costs.
.464 Lumber prices.
.47 Lumber and timber economics.
.471 Lumber production.
.472 Lumber consumption. (See also .93.)
.473 Lumber trade. (See also .95.)
.474 Timber bonds.
.475 Timber insurance.

.48 Lumber and timber associations.
.5 **Wood technology.**
.51 Timber physics. (For different species see .1476.)
.511 Structure and identification of wood. (See also .11.)
.512 Physical properties of wood.
.513 Mechanical properties of wood. Timber testing.
.514 Chemical properties of wood. (See also .436, .4411, .442, .443, .446, and .447.)
.52 Conditioning of wood.
.521 Air seasoning. (See also .4221.)
.522 Kiln drying. (See also .4222.)
.53 Wood preservation.
.531 Preservatives.
.532 Methods and costs.
.533 Treating plants and apparatus.
.54 Wood substitutes.
.6 **Forest engineering.** (For logging engineering see .41.)
.61 Surveying. (For logging railroad surveying see .41221.)
.611 Land surveying. Forest boundary surveys. (See also .7321.)
.612 Topographic surveying. (See also .7321.)
.62 Mapping. (See also .7321.)
.63 Construction engineering. (For logging and forestation machinery and equipment, logging railroad, sawmill, paper mill, and seed extraction plant construction and equipment, see .41, .25, .41221, .42, .431, and .2513, respectively.)
.631 Roads.
.632 Trails.
.633 Bridges. (For logging railroad bridges see .41221.)
.634 Telephone lines.
.635 Buildings.
.636 Fences.
.637 Lookout towers and special protective works.
.64 Hydraulic engineering (including reservoirs, dams, and conduits).
.641 Irrigation.
.642 Domestic water development.
.65 Hydroelectrical engineering. (See also .97113.)
.66 Camp management.
.661 Camp equipment.
.662 Commissary and dietary.
.663 Camp sanitation.
.664 First aid and medical data.
.665 Veterinary data. (See also .8487.)
.7 **Forest Management.**
.71 Forest mensuration.
.711 Measurement of logs.
.7111 Board measure. Log rules. Scaling.
.7112 Cubic measure.
.712 Measurement of lumber. (See also .423.)

.713 Measurement of other forest products.
.714 Measurement of felled trees.
.715 Measurement of standing trees.
.7151 Volume tables. (For different species see .14746.)
.7152 Form factors. (For different species see .14746.)
.7153 Taper tables. (For different species see .14746.)
.716 Determination of contents of stands. (See also .7321.)
.7161 Measurement of all trees.
.7162 Use of sample trees.
.7163 Use of sample plots.
.7164 Ocular estimation.
.717 Determination of age of trees and stands.
.718 Determination of growth. Accretion and increment.
.7181 Of single trees. (For growth tables for different species see .14747.)
.7182 Of entire stands.
.719 Determination of yield.
.7191 Yield tables. (For different species see .14748.)
.7192 Permanent sample plots.
.72 Forest finance.
.721 Forest valuation. Determination of forest values.
.7211 Economic and mathematical principles.
.7212 Investments and costs in forest production.
.7213 Valuation of forest soil. Land values.
.7214 Valuation of growing stock or timber.
.7215 Valuation of entire forests.
.7216 Stumpage values and appraisals. (See also .97111.)
.7217 Appraisal of damages.
.7218 Forest taxation. (See also .962.)
.722 Forest statics. Comparison of forest values.
.7221 Determination of profits in forestry.
.7222 Determination of forest per cent.
.7223 Financial test of methods of treatment.
.7224 Comparison of forest with agricultural values. (See also .9711.)
.73 Forest organization. Forest regulation.
.731 Fundamental premises and principles.
.7311 The increment. (See also .718.)
.7312 The rotation. (See also .717.)
.7313 The cutting cycle.
.7314 The normal forest.
.732 Forest working plans.
.7321 Forest survey. Timber surveys. Forest reconnaissance. Collection of data. (See also .611, .612, .62, and .716.)
.7322 Determination of methods of treatment.
.7323 Regulation of yield. Determination of felling budget.
.7324 Control and revision of working plans. Working plan control.
.7325 Forest working plans for special areas.

.74 Forest administration.
.741 Personnel and organization of forest staff.
.7411 Federal. (See also .971.)
.7412 State. (See also .972.)
.7413 Municipal. (See also .973.)
.7414 Private. (See also .974.)
.742 Forest business practice. Forest accounting.
.7421 Federal. (See also .971.)
.7422 State. (See also .972.)
.7423 Municipal. (See also .973.)
.7424 Private. (See also .974.)
.743 Forest equipment (includes all general equipment, for special technical equipment see specific captions).
.744 Game and fish.
.7441 Game and fish administration.
.74411 Laws and regulations.
.74412 Cooperation. (See also .9712.)
.74413 Refuges.
.7442 Game and fish management.
.74421 Game census.
.74422 Regulation of kill.
.8 **Grazing.**
.81 Live stock industry.
.811 Cattle and horses.
.8111 United States (alphabetically by states).
.8112 Foreign countries (alphabetically by countries).
.812 Sheep and goats.
.8121 United States (alphabetically by states).
.8122 Foreign countries (alphabetically by countries).
.82 Forage plants (alphabetically by species). (For arborescent species see .13.)
.821 Identification.
.822 Distribution.
.823 Seasons of growth.
.824 Forage value. Economic importance.
.83 Forage types.
.84 Range management. (See also .97116.)
.841 Range reconnaissance.
.842 Adaptability of range to different classes of stock.
.843 Seasons of grazing.
.844 Intensity of grazing.
.845 Carrying capacity.
.846 Systems of range allotment.
.847 Distribution of stock.
.848 Handling stock.
.8481 Herding.
.8482 Branding.
.8483 Counting.

.8484 Salting.
.8485 Watering. (See also .8495.)
.8486 Protection from flies.
.8487 Prevention and treatment of disease. (See also .665.)
.8488 Lambing and kidding.
.8489 Shearing of sheep and goats.
.849 Range improvement.
.8491 Natural reseeding.
.8492 Artificial reseeding.
.8493 Eradication of poisonous and unpalatable plants
.8494 Drift and division fences. (For engineering features see .636.)
.8495 Development of stock watering places. (See also .8485.)
.8496 Control of range destroying rodents.
.8497 Control of predatory animals.
.85 Grazing influences. (See also .341 and .91.)
.851 Forest reproduction.
.852 Forest fires.
.853 Erosion and streamflow.
.854 Landslides and avalanches.
.855 Water for irrigation and municipal water supply.
.856 Soil fertility.
.86 Range economics.
.9 **Forest economics.** (For forest statistics see individual topics on which statistics are desired.)
.91 Forest influences. (See also .85.)
.911 Climate.
.912 Soil.
.913 Water resources and streamflow.
.914 Erosion.
.915 Avalanches.
.916 Public health.
.917 Ethics and morals.
.918 Aesthetics.
.92 Industrial relation of forests.
.921 Wood-working.
.922 Agriculture.
.923 Railroading.
.924 Mining.
.93 Demand for forest products. (See also .453 and .472.)
.94 Forest resources. Forest conditions. Forest production. (See also .97111.)
.941 United States (aplhabetically by states). (See also .091 and. 161.)
.942 Foreign countries (alphabetically by countries). (See also .092 and .162.)
.95 Tariff on lumber and forest products. (See also .471.)
.951 Exports.
.952 Imports.

.96	Forest legislation (alphabetically by countries and states). (For game and fish legislation see .74411.)
.961	Fire. (See also .31.)
.962	Tax. (See also .7218.)
.97	Forest policy.
.971	National forest policy. (See also .091, .7411, and .7421.)
.9711	Utility of national forests.
.97111	Timber production and silvicultural policy. (See also .94.)
.97112	Watershed protection. (See also .2538.)
.97113	Waterpower development. (See also .65.)
.97114	Public use and recreational purposes. (See also .916, .917, and .918.)
.97115	Use of agricultural lands. (See also .7224.)
.97116	Use of grazing lands and grazing policy.
.97117	Use of mineral lands.
.97118	Other uses.
.9712	Game and fish policy. (See also .744.)
.9713	Educational policy. (See also .07.)
.9714	Development of science by investigation and research.
.9715	Cooperation and demonstration.
.9716	Regulation of privately owned forests.
.972	State forest policies (alphabetically by states). (See also .091, .7412, and .7422.)
.9721	Land policy.
.9722	Silvicultural policy.
.9723	Grazing policy.
.9724	Educational policy. (See also .07.)
.9725	Cooperation and demonstration.
.9726	Regulation of privately owned forests.
.973	Municipal forest policies (alphabetically by states and municipalities). (See also .091, .7413, and .7423.)
.974	Private forest policies (alphabetically by states and individuals or corporations). (See also .091, .7414, and .7424.)
975	Foreign forest policies (alphabetically by countries). (See also .092.)

A SECOND-GROWTH PINE MILL IN CALIFORNIA

By Swift Berry

Forest Examiner, Forest Service

The possibilities of an early second cut on accessible cut-over lands in California are indicated by the operations of a small mill near Grass Valley, in Nevada County. This mill is manufacturing lumber from second-growth yellow pine and incense cedar trees ranging from 40 to 50 years in age. The trees range from 10 to 18 inches in diameter, breast high, and no logs are cut smaller than 12 feet long and 10 inches in diameter at the top. The object of the operator in installing the mill was to clear the land for a large orchard, but that does not prevent the milling operation from being conducted at a nice profit.

The mill is of the small circular type, with a 40-inch saw, a single saw edger, and one cut-off saw; power for the whole being furnished by a 25 h. p. engine. A crew of three men operates the mill, and a fourth man piles the lumber and takes care of the lumber yard. The skidding of the logs is done by one man and a team. The output during the season of 1916 was a little over 100 thousand feet board measure. No clear lumber is produced, but much of the cut is good common lumber. The knots are small and mostly tight. According to the operator, the local people are pleased with the lumber, and it does not warp or check more than other common pine lumber of the lower Sierras. An examination of the yard did not disclose any unusual warping. A few 4 by 4 inch timbers cut partly from the heart had twisted. All sorts of common lumber are cut, except that there is difficulty in getting inch boards over 10 inches in width. The lumber is sold at the mill to ranchers, who haul it away, at $19.50 per thousand. Another interesting point is the close utilization secured because of the proximity to markets. Edgings are cut into fence pickets, and slabs into kindling wood. The sawdust is used as a mulch in the newly planted orchards. All trees below 10 inches in diameter and all tops below 8 inches are cut into cordwood.

REVIEWS

Report of the Director of Forestry for the Year 1916. By R. H. Campbell. (Part VI, Annual Report, Department of the Interior.) Department of the Interior. Ottawa, Canada. 1917. Pp. 95.

In spite of the war, which curtailed the force by enlistments (some 55 employes having enlisted) and made retrenchments in expenditures desirable, the appropriation for the forest service was hardly curtailed and amounted to $750,000, most of which was expended during the year.

We note that 60 per cent of the expenditure is spent on forest reserves, including planting; over 25 per cent on fire ranging; overhead charges amounted to between 7 and 8 per cent; and another 8 per cent goes to the forest products laboratories; the balance for collecting statistics and making surveys. The working force on the forest reserves consisted of four district inspectors, 9 supervisors in charge of reserves, 13 forest assistants, 79 forest rangers, and 17 office staff, or a total of 122, which is increased during the fire season by 189 temporary rangers.

When it is considered that this force is attempting to protect and manage around 30 million acres, the magnitude of the task, and, indeed, the impossibility of encompassing much, is apparent. As a matter of fact, making accessible and preparing these national forests for management is still the main task. A summary of the improvement work shows construction of ranger houses and cabins, stables and other buildings to have consumed $40,000; roads, trails and bridges, around $50,000; telephone lines, lookout towers, etc., $20,000. It may be of interest to note that roads and trails can be constructed within $60 per mile; telephone lines, within $70; and lookout towers within $150.

Fires are still the bane of Canada in general and, in spite of better protection, of the national forests. Although the records are incomplete, at least some two million acres are reported as burned during the year, one-half being chargeable against the Hudson Bay railroad construction, a government institution! Otherwise, railroads as a cause of fires have been greatly reduced, for, while in the collected data, unknown causes are accredited with 36 per cent (leaving out fractions) of the number of fires, campers and travelers with 28 per cent, settlers with 17 per cent, the railroads are responsible for only a little over 8 per cent. This is due to the organization perfected by the Railway Commission

under the stimulus of the Commission of Conservation, in which the Forestry Branch cooperates. Curiously enough, the government railroads do not come under this jurisdiction and are great sinners.

The financial loss of the fire harvest is not estimated, but from the material data given, one would be justified to place it at least at 5 to 6 million dollars. One large fire burned nearly 100,000 acres.

That the reservations suffer in the same proportion appears from the fact, that, while for the country on the whole (leaving out the Hudson Bay railroad territory) 1,455 fires burning over 905,000 acres were reported, on the reserves 205 fires, burning over 360,000 acres, occurred, the percentage of the causes being almost identical. Lightning is charged with over 4 per cent (2.4 on reserves). The fires on the reserves, to be sure, come in mostly from outside.

The timber operations which the Forestry Branch supervises are small, but are now carried on conservatively, including brush disposal, which has been proved quite practicable, financially and otherwise. Unfortunately, before the reservations were set aside, most of the good timber had been disposed of to timberlimit holders, and the supervision of their work, ridiculously enough, is placed in another branch of the Department of the Interior, thus dividing authority in the reserves, much to their detriment.

Systematic planting on reserves, which has hitherto been sporadic and experimental, is to be begun, or was begun in 1916, the large nurseries at Indian Head, and the new one at Sutherland, to furnish the plant material. For this purpose, on sandy sites, white spruce, 3-year-olds, jack pine and Scotch pine, 2-year-olds, are to be used as having demonstrated best and cheapest results, seeding and one-year-olds having proved a failure.

The first-named nursery distributed over 4.5 million plants for prairie planting, around 1,000 plants to the single applicant.

The whole revenue of the reserves from all sources does not come to $34,000, while the expenditure for nurseries and planting amounts to nearly $50,000.

Fish, game, and grazing regulations also occupy the forest officers. In the game protection a cooperation with the provincial authorities which administer the game laws is practised. Formerly, hunting on reserves was generally forbidden, now parts of reserves are limited to serve as game sanctuaries, while adjacent territory is open to hunting, thereby relieving a certain amount of opposition to extension of forest reserves.

No additions to the reserved area were made during the year, but six reconnaissance parties were engaged through the summer—Toronto students are used for this purpose—looking over some 30,000 square miles to determine the desirability of reserving portions.

It may be of interest to note that one of these surveys, embodying nearly 14,000 square miles in the Peace River country, containing 12 billion feet of saw timber, was made at a cost of 42 cents per square mile. Some 6,789 square miles of this area were recommended for reservation.

From a statistical table and discussion, it appears that the total value of forest products for the year 1915 was placed at $172,880,000; quantities are not given, but we note that lumber, lath and shingles represent in value about 40 per cent, fuelwood 35 per cent and pulpwood less than 10 per cent of this total.

The total cut of pulpwood was 2,355,550 cords, of which nearly 60 per cent was used in Canadian mills, 40 per cent being exported to the United States. Only eight years ago the condition was reversed, the larger portion being exported.

The general report of the director is followed by reports from the four district inspectors of reserves, the districts coinciding with the four provincial boundaries, from the tree planting division and the forest products laboratories.

Drouth is, of course, the bane of the nurseries, which are located in the dry plains country, as well as frost; and these troubles were particularly bad in the season reported; exceptionally late and severe frosts in some cases killed 35 to 40 per cent of the stock; the ashes were twice defoliated. "Following two exceptionally dry seasons, the subsoil was completely dried out, and the rains, though heavy, were unable to penetrate deeply enough to reach the tree roots in poorly cultivated land." Insects, especially aphids and canker worm, are also complained of.

The nurseries are too well established to be moved, but it has always appeared to us a mistake to place them in climatically difficult country under the mistaken notion that the plants should be grown under the natural conditions under which they are to be used; the importance of the climatic derivation of the seed being meanwhile, considered much less important.

The species grown for free distribution are to the largest extent broadleaf, some 29 acres of Manitoba maple, some 45 acres of ash (green?), 4 acres of Russian poplar, several varieties; 3 acres of willows,

and 5 acres of Caragana, which has proved itself an excellent windbreak material, and of which also seed is sent out; some 10 acres are devoted to conifers, Scotch, jack, and lodgepole pine, and white spruce. Altogether 97 acres are bearing stock.

There are also blocks of permanent plantations made of varying composition at various times, within the last ten or twelve years, with the view of finding the most desirable species or composition.

On these, measurements are made annually. In the ten years the average height attained showed maple and white birch the best, with 18 feet, but tamarack came within half a foot of this, while Scotch pine made 12, spruce 10 feet.

From the forest products laboratories, located at Montreal, progress is reported; results were published in one bulletin on treated woodblock paving and in various journals.

Besides timber physics work and timber testing of the usual kind, and other miscellaneous work, special investigations were instituted with reference to various problems in pulp and paper, for which a first-class paper machine is installed; intensive testing of Douglas fir; preservative treatment of mine timbers, and of railroad ties, fence posts and paving blocks; the study of acetone for war purposes, and of potash from wood; oils from wood for ore flotation.

The reports of the district inspectors give sufficient detail of information on the woods work. While there is nothing phenomenal recorded in the reports, they show steady and rational progress in developing the gradual change from mere timber administration to forest management. B. E. F.

New Hampshire Forestry Report, 1915-16. By E. C. Hirst, State Forester. Biennial Report of the Forestry Commission, New Hampshire State Board of Forestry. Concord. Pp. 177.

California Forestry Report, 1916. By G. M. Homans, State Forester. Sixth Biennial Report of the State Forester of the State of California. Sacramento. Pp. 56.

Annual Progress Report Upon State Forest Administration in South Australia, 1915-16. By Walter Gill, F. L. S., F. R. H. S., J. P., Hon. Vice-President Forestry Society of California, Conservator of Forests. Pp. 13.

Of these three reports, by far the most interesting and instructive is that by E. C. Hirst. New Hampshire reports have always been of unusual interest. There was the detailed study of forests in northern

New Hampshire, by A. K. Chittenden; then the bulletin of forest conditions in central and southern New Hampshire, including notable yield tables, by C. A. Lyford and Louis Margolin. The report by J. H. Foster covered the subject of forest taxation. The last report for the year 1915-16 covers the forest fire service, reforestation, public forest, and educational and other special projects. The review of forest protection is a notable one, and doubtless the results in the field are as efficient as they appear on paper. Lookout stations, patrol service, prevention of railroad fires, disposal of slash, and fire organizations are all treated in some detail. The recommendations for better forest protection (pages 44-45) are specially interesting, and include plans for more fire lookout stations, even more active cooperation with other protective agencies, more general fire educational work, licensing of portable steam sawmills, and authorizing the use of town wardens, deputies and regular employes in forest administration. The article on possibilities of timber insurance, by W. R. Brown, is interesting, but unquestionably the problem of forest fire insurance is a delicate one. It has met with setbacks, even with the well-organized fire protection of a European country like France. The statement on National Forests, by Forest Supervisor Benedict, is of wide interest, and shows what the national Government is doing in New Hampshire in the improvement, protection, and management of the National Forest in that region, acquired by purchase under the Weeks act. Already there is more than 325,000 acres in the White Mountain National Forest in New Hampshire. It is interesting to note the increasing number of State and municipal demonstration forests, as well as the examples of private forestry practiced with commercial success. Unquestionably, the State Forester is to be congratulated on the excellence of this showing.

The Sixth Biennial Report of State Forester Homans of California is somewhat disappointing. It does not compare in quality or in interest with that of New Hampshire, but withal it contains some data of interest. The fire data for 1915 show that outside the National Forests there were 434 fires, 644,038 acres burned over, with a total damage of more than $220,000. It is presumed that this is not a complete list of all fires, but rather the more important ones, and it is encouraging to note that there were 114 fire investigations "made during the past two seasons. . . . Wherever we have made investigations of fires, the sentiment throughout the community has been

one in favor of an adequate forest protection." Four fire protective associations are mentioned, and an interesting account of fire protection by lumber companies. Considerable space is devoted to city tree planting, and there is an excellent article by DuBois, entitled "Summer Homes on the National Forests." The data on eucalyptus plantation investigations show that the forestation by commercial companies has been far from successful. Curiously enough, there is only an insert sheet giving the results of these investigations. Considering the importance of protecting investors from unscrupulous eucalyptus companies, it is unfortunate that more space was not devoted to the results of this investigation.

The report for the year ended June 30, 1916, by Conservator Walter Gill, dated Adelaide, October 19, 1916, is chiefly of interest because of the data it contains on eucalyptus plantations. The results of these plantations are admirably illustrated in the appendix. The student of forest administration, however, could glean additional data of interest. The planting of the past was 75 per cent successful. The expenditures on forests, according to Table 5, for the period of 1876 to 1916 were £367,523 and the revenues less than £200,000.

T. S. W., Jr.

New Haven, Conn.

Sixteenth Annual Report of the State Board of Forestry, 1916. State of Indiana. Indianapolis, Ind. 1917. Pp. 217.

Out of the 217 pages in this report, at least 150 pages are devoted to educational and propagandist matter, and the balance of space, the report proper, also is mainly or wholly educational in character. In other words, although the State Board of Forestry had had a career of sixteen years, the State forest idea—a policy of recuperation under active State guidance—is still foreign to it. Perhaps this is due to the fact that Indiana's forests are entirely in farmers' woodlots, and hence the State can act only as an educator. We do not know whether more than "puttering" is practicable. There is, however, in the hands of the board, a State forest reservation of 2,000 acres, purchased by the State for $16,000 in 1903, located in southern Indiana, which is used for demonstration purposes, State nurseries, etc., and also as a park. Of the total appropriation of $8,000, the sum of $3,000 is set aside for the reservation, against which a credit of $200 for wood sold. Oak, hickory, beech, and in some parts the scrub pine (*P. virginiana*) are the principal trees.

Some of the ground is agricultural, other parts topographically unfit for such use. Abandoned fields with an area of 213 acres have been planted. Since this area lies in 79 tracts, the planting can only be for demonstration purposes. There are, however, some tracts as large as 8 to 10, and one of 28 acres. A description of each of these sample plantings forms the principal part of the report. The planting is, of course, almost entirely of hardwoods.

Pruning and thinning, or rather improvement felling experiments, and some in natural regeneration, have also been carried on. We have not noticed in the accounts anything of a striking nature, except that an attempt to reforest the largest area by nuts of Black walnut, hickory, and oak proved a failure, apparently because coppice shoots were interfering. On another plot some of the walnuts, grown from nuts, when 6 years old, so far as not straight were coppiced, and the coppicing was repeated. It is not quite clear what the object of the experiment is, unless to secure the more rapid growth of the coppice shoots, which, however, is not persistent. It seems also that coppice shoots are less liable to "fork."

In a "woodlot demonstration" in another part of the State, which we would have expected to have to do with an existing woodlot, this resolves itself also into a plantation of 1¾ acres, on which a number of non-indigenous trees are used, notably some conifers.

An account of prize essays and of a forestry exhibit is followed by a number of educational articles, among which one by the well-known dendrologist, Prof. Stanley Coulter, on fifty-four of the tree species of Indiana, including some introduced ones in the reservation. The report is well illustrated and printed on good paper, worthy of a State document. B. E. F.

Canadian Woods for Structural Timbers. Bulletin 59, Dominion Forestry Branch. Prepared at the Forest Products Laboratories of Canada by H. N. Lee under the direction of J. S. Bates. Ottawa, Canada. 1917. Pp. 44.

This bulletin is composite in character, evidently with a view to inform the general wood user. It opens with a brief statement of the timber supply of each province and the character of the forest. This is followed by a short description of the general properties of wood, largely as related to the mechanical qualities.

The bulk of the text is given up to a discussion of the most important coniferous woods of Canada, mainly from the standpoint of their

properties and uses. Much attention is given naturally to a comparison of Douglas fir and southern pines. A statement is given summing up the existing information on the comparative strengths of Douglas fir and longleaf pine structural timbers. Douglas fir beams are stronger in fiber stress at the elastic limit, though weaker in modulus of rupture (average of both about 10 per cent); weaker in longitudinal shear where used as very short beams (20 to 25 per cent); stiffer (5 per cent); weaker in compression parallel to grain (10 to 20 per cent), but stronger in compression perpendicular to grain (10 per cent); and averages about 20 per cent lighter in weight.

The subject of grading rules in connection with structural timbers is briefly treated, bringing out the relative influence of the various defects upon strength. Efficient grading rules must be evolved for British Columbia fir, if it is to compete with longleaf timbers.

We are glad to see this bulletin issued to the Canadian wood user, and trust it is but the forerunner of many others to help educate the public to a more intensive and intelligent utilization of native woods.

J. H. W.

Report on Timber Import Trade of Australia. By H. R. MacMillan. Supplement to Weekly Bulletin of the Department of Trade and Commerce. Ottawa, Canada. 1917. Pp. 76.

The underlying cause for the visit of Mr. MacMillan to Australia and for the preparation of this report is expressed in his first sentence: "The serious decline of Canada's share of Australia's timber imports would at any time demand attention. That this loss of trade in raw products between two neighboring British dominions should occur at a time when imperial sentiment is strengthening, when the move for closer imperial trade relations is gaining favor, and should be most marked in a trade in which Canada not only possesses all the natural advantages, but in which she has greatly increased her productive capacity during the period of trade, is a matter of serious concern." During twenty-five years the Canadian export to Australia was rarely over 10 per cent of the Pacific Coast export; in 1913 it was only 3 per cent of the total, and hardly 5 per cent of the Pacific Coast export.

Although in the comparative tables Japan is not mentioned, in the text the statement is made that Japan, which exports a poor pine for box boards, has outdistanced Canada in the Australian timber trade, and

altogether all other countries have increased their trade during the decade except Canada and New Zealand.

Active competition of the United States corporations and unprofitable dumping of surplus stock by these, it is found, has kept Canadian producers from this market.

The Australian market, however, is a growing one—in ten years, from 1903 to 1913, it increased 142 per cent!—and recent organization of the export trade from the Pacific Coast promises to regulate it in such a manner as to make it profitable for Canadian operators trading with a sister colony.

The report is divided into seven sections, namely: Influence of Native Timber on the Australian Markets; The Use of Timber in Australia; Timber Imports of Australia; Manner in Which Importation of Timber Is Handled; Discussion of Australian Imports by Classes; Canada's Position in Australian Timber Imports; Future Possibilities.

While for the last twenty years or so Australia has taken at the rate of 100,000,000 feet, mainly Douglas fir, from the Pacific Coast, her supplies of native timber have shrunk so that a rapid increase of imports is bound to come. Australian forests are almost wholly mixed hardwoods, belonging mainly to the eucalypts and acacias, sometimes as enormously developed as the Pacific Coast timber—200,000 feet to the acre and up to 360,000 feet. Jarrah and karri are the export species—jarrah on account of its durability, combined with strength and hardness, for railroad ties; karri, lacking durability, but having the other qualities; several others, being teredo-proof, for piling and marine works. All are hard and difficult to work. The lack is in softwoods, hence American and European coniferous material are imported (at the rate of 60 feet per capita in western Australia). There are several species of pine, chiefly in New South Wales and Queensland, but so scattered over inaccessible country as to make exploitation costly. Even the good timber is unfavorably located, so that few mills can put timber on the market for $35 per M, and in many instances the cost goes up to $45 more than the imported wood. The prices for imported rough lumber quoted in Sydney run from $44.40 to $46.80, while home woods bring $48 to $62.40. Fire and ring-barking (for the sake of pasturing) has injured much of the native forest.

The consumption of lumber and timber, leaving out posts, piles,

and fence material, is around one billion feet, valued at 32 million dollars, half of it imported; that is, a little less than 200 feet, b. m., per capita, as against 800 feet on the treeless Canadian prairie, where wooden buildings prevail and new settlements are rapidly developing, while the settlements in Australia grow only slowly and two-fifths of the population lives in six cities; brickbuilding even in the timber country is usual. Nevertheless, the bulk of the importation of Douglas fir, which represents 70 per cent of all kinds imported, to the extent of 75 per cent, is used for building purposes.

A very considerable customs tariff—$9.60 per M on dressed, and, according to size, from $2.40 for rough lumber, the lower figure for 6 by 12-inch and over—is designed to stimulate manufactures at home. The lower duty for the large-size timber is a direct encouragement of the use of Douglas fir, the only timber that can supply such sizes in large quantity and of the quality sought, which is of a higher grade than is usually employed in its home for similar purposes.

The methods of conducting the lumber business and the various uses to which wood are put are discussed in detail, the latter always with a natural bias toward Douglas fir.

In the importation of dressed lumber, which pays $7.20 duty, curiously enough, Norway and Sweden take first place, almost monopolizing the trade, as they have in Africa and South America, in spite of the knotty material, particularly of spruce, that they ship. They see to excellent manufacture and grading, however, and to careful handling.

The low duty on logs—5 per cent ad valorem—has really had the effect of increasing their importation, especially from Japan and Russia.

Advice as to how to overcome the present condition of no Australian trade for Canada is given in conclusion. The author advocates a cooperating group of mills, able to quote on all inquiries and to act quickly on them; an exporting company similar to the American, through which the mills can act; cooperation with American mills to keep up a profitable price level, to adjust grades, and to educate the market.

The report is comprehensive and clear. That it was prepared by a forester as timber trade commissioner is a further testimony to the growing conviction that the technically educated man may be the fittest man to deal even with trade questions most efficiently. B. E. F.

Land Settlement in Western Australia. The International Review of Agricultural Economics. Seventh year, No. 12. December, 1916.

Western Australia is the largest State of the Australian Commonwealth, forming 32.81 per cent of its land surface. Since its population is only 323,018, it is clear that its problems relative to land settlement are important. The area of land already alienated from the crown in 1914 was 7,795,319 acres. This figure, however, includes roads and public reserves. The government also offers large areas of land for selection under various schemes of conditional purchase. The conditions generally include residence on the holding and the execution of certain improvements, and provide for terms of deferred payments extending over a series of years. When the conditions have been fulfilled a crown grant for the lands may be issued to the selector.

Dr. J. W. Paterson, professor of agriculture in the University of Western Australia, describes the chief provisions for land settlement. We will briefly resume his statements.

Free Homestead Farms.—Free homestead farms are granted, and the survey fee when separate survey is required. If included in a larger block of 500 acres or over, already surveyed, no further charge is made for survey. Any person who is the head of a family, or a male over 16 years who does not already hold more than 100 acres, may obtain a homestead farm. He must, however, reside on the farm for six months of each of the first five years, and spend on improvements an aggregate sum of $3.41 per acre in certain periodical installments during the first seven years. Of the amount spent on improvements $146 may go toward a house, and part toward the fencing of the property, which must be completed in seven years. Half the cost of fencing is credited as improvements. At the end of this period, and provided the conditions have been complied with, a crown grant may be acquired costing $7.30.

Conditional Purchase with Residence.—Areas of from 100 to 1,000 acres of such lands, which may include a free homestead block, are granted under conditional purchase at prices ranging from $2.43 per acre upward, payable in half-yearly installments. If the purchase money be $2.43 per acre, the price is payable at the rate of 32 cents per annum during twenty years, and if $3.65 per acre at 12 cents per annum during thirty years. If the price be over $3.65 per acre, the sum is still repaid in thirty years, but at a higher annual rate. The lat-

est amendment also provides that payments under this section may be deferred for five years if the land be over 12½ miles from the railway. The scheme requires residence for six months of each of the first five years, either by owner, wife, parent or child over 16. Improvements during the first ten years must in the aggregate equal the purchase money (but need not exceed $4.87 per acre), at the rate of one-fifth of the purchase money every two years from date of occupation. Improvements include that one-half of the land must be fenced within five years and the whole within ten years. Half the cost of exterior fencing is credited as improvements.

Conditional Purchase Without Residence.—One thousand acres of cultivable land can be selected without conditions of residence. It is provided that the total value of the improvements during ten years shall be 50 per cent over and above the amount of purchase money, but need not exceed $7.30 per acre. The occupier of an adjoining farm under residential conditions may also select under this section, which may give him a total holding of 2,000 acres.

Conditional Purchase by Direct Payment.—A similar area of land, at a similar price to that of the two preceding sections, may be acquired by direct payments during the first twelve months. The purchaser must within three years ring-fence the whole of his land, and within seven years expend in prescribed improvements, in addition to the exterior fencing, an amount equal to $2.43 per acre. In practice this section of the Act is little availed of.

Area of Wheat Farms.—The minimum area of land taken up in the wheat-growing districts is usually 1,000 acres. The calculation is that one man and team can work from 250 to 390 acres of crop in one year. With one team the wheat can then be worked in rotation with fallow and sheep—a system which only takes one crop from the same land every two or three years. The year of fallow in districts below the 15-degree rainfall level is most desirable in order to store up soil moisture; fallowing, moreover, permits the work of ploughing and preparing the land for the next crop to be performed while the present crop is growing. It also, and particularly with a three years' rotation carrying sheep, enables the stubble or straw left standing by the harvester to be plouged in and thus maintain the supply of humus; otherwise straw would be burnt off. Large farms in the wheat belt are on these grounds encouraged as a matter of policy. While 2,000 acres of cultivable land is the maximum allowed to one holder, under section

55, along with 56, the holder's wife (or husband) may still acquire an additional 1,000 acres under non-residence conditions. The larger area is often useful in the case of a family working several teams.

Costs of Clearing.—On the large farms of the wheat belt the natural timber and scrub is lighter, and the cost of clearing bush lands there for the plough usually ranges from $3.65 to $6.08 per acre. The cost is credited to improvements. In the wetter mixed-farming districts of the southwest the clearing is much heavier, and may cost from $24.33 to $121.67 per acre. It is so heavy that—except for orchard purposes—it will often render the undertaking unprofitable to the pioneer. Moreover, the land commonly also requires drainage.

Conditional Purchase of Land for Orchards, Vineyards or Gardens.—Small blocks of 5 to 50 acres can be acquired at from $5 per acre, payable by installments within three years. The sale is made under certain conditions of fencing and partial planting of the area within four years.

Conditional Purchase of Grazing Lands.—Areas of 300 to 5,000 acres of such lands may be acquired at prices ranging from 91 cents up to $2.43 per acre, payable in forty half-yearly installments, and subject to certain conditions of residence during the first five years by the selector, his agent or servant. Improvement valued at one-fifth of the purchase money must be made every two years of the first ten years. Half the cost of fencing is credited as improvements. If the land carries poison plants, the price may now be reduced to 61 cents, this provision being also retrospective for lands selected after 1905.

In estimating the area held by a selector of 2,500 acres of grazing land is reckoned equal to 1,000 acres of cultivable land, and, therefore, a person holding 1,000 acres of the latter may select a further 2,500 acres of grazing land, or, if he hold 2,000 acres of cultivable land under residence and under non-residence conditions, his wife may select 25,000 acres of grazing land.

Apart from conditional purchase of land, large areas of grazing land may be leased under the Acts at an annual rental. The rent is almost nominal, and in different divisions of the State ranges from 73 cents up to $4.87 per 1,000 acres. The minimum area is usually 20,000 acres, and sometimes 50,000 acres, according to location. The Act generally prescribes that pastoral leases shall be stocked at the rate of ten sheep or one head of large stock for every 1,000 acres within two years from their commencement, failing which they are liable to for-

feiture. Before any land in a pastoral lease is made available for selection, under conditional purchase, it must, except in the southwest division, be resumed, and twelve months' notice be given to the lessee, who is also entitled to compensation for any prescribed improvements on the land so resumed. All pastoral leases granted under the Act expire in December, 1928.

Apart from the settlement of crown lands, the government may also repurchase alienated lands for the purpose of cutting them up into blocks of suitable size and throwing them open for settlement on certain terms and conditions. In western Australia lands wanted for closer settlement can only be acquired voluntarily. Under the Agricultural Lands Purchase Act (1909), which repealed and consolidated previous legislation, sums not exceeding $19,466.80 in the aggregate (since increased to $2,920,020) may be expended on the repurchase of lands near the railways suitable for immediate cultivation. A land purchase board has been appointed to administer the Act. After reservation of part of the land for public purposes, the remainder is thrown open for selection—the selling price being then equal to 105 per cent of the purchase price plus the cost of any improvements. Payments of principal and interest are spread over twenty years in half-yearly installments of $18.92 for each $487 of the selling price. There are also improvement conditions. The maximum land selected under the scheme must not exceed 1,000 acres; in exceptional cases, 2,000 acres.

Farm Forestry. By John Arden Ferguson, Professor of Forestry at the Pennsylvania State College. John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London. 1916. Pp. 233.

This is a text-book for students in agricultural colleges and high schools. As would be expected, it covers in a rather simple manner the aspects of forestry which it seems desirable to impart to students who are seeking a general knowledge of the subject without intending to pursue it to any great depth. The book takes up briefly some of the economic aspects of the woodlot, the structure and life processes of trees, and the various subjects connected with the establishment, care, protection, and management of a woodlot. Discussions of the more important North American trees found east of the Rocky Mountains and their adaptability to different regions, the measuring and harvest-

ing of woodlot products, the properties of woods, and methods of preservative treatment are other subjects considered. In the appendix the author suggests a list of practicum exercises that could be given in connection with a course in farm forestry, describes a method of finding the area of a woodlot by the use of an ordinary compass, and includes a few tables.

The method described of finding the area of a woodlot is very simple in so far as running the compass-line around the woodlot and drawing the map are concerned. In computing the area from this map, however, the author has recourse to dividing it into a large number of squares. While correct, this method makes the problem more complicated than is necessary. Instead of computing the area by these squares, it would have been much simpler to have divided it into two triangles and computed the areas of these.

The tables include the Scribner and Doyle rules for determining the contents of logs, the area of circles in square feet, and volumes in board or cubic feet of several species of Eastern trees. The log rules and volume tables are doubtless intended principally for illustration, since they by no means cover the field to which the text applies.

The book is rather abundantly illustrated, although a number of the illustrations are not especially suggestive or representative of woodlot conditions. The author does not claim originality for the material, and, in fact, practically all the information presented is available in other publications. He states that the aim has been to bring together in available form ideas and principles already well known. In doing this he has performed a service which will be appreciated, particularly by those teaching elementary courses in forestry, in that the book will serve admirably as a text for students and also as a guide for somewhat more comprehensive lectures. C. R. T.

The Trees of Vermont. By G. P. Burns and C. H. Otis. Bulletin 194, Vermont Agricultural Experiment Station. Burlington, Vt. March, 1916. Pp. 244.

This is a descriptive bulletin written primarily for public school pupils and others not specially trained in botany.

It is very largely a reprinting of a handbook on Michigan trees, issued by the same authors in 1913, with modifications to suit the Vermont flora. Following introductory remarks on the study of trees and use of artificial keys come generic keys (both summer and winter

condition), leading to the main body of the text. The style is uniform —a page of description facing one of drawings, with keys to the species. Some bark illustrations are given.

One additional feature in this publication is the section relating to the common lumber woods. The subject of wood structure is briefly taken up, followed by an artificial key to the species of wood.

J. H. W.

Plant Succession. An Analysis of the Development of Vegetation. By F. E. Clements. Publication 242, Carnegie Institution of Washington. Washington, D. C. 1916. Pp. 512.

To review a book of such size and importance as this volume, and to bring out the special interest which the forester has in it, must be left to competent hands and time. For the present, we consider it, however, proper to give at least this book notice, in order to make our readers cognizant of its existence.

Briefly stated, it is a critical analysis of the facts and principles of plant succession and a digest of methods for investigating successional phenomena. A very full historical review of the development of ecological studies is a welcome addition. In the analysis of the causes of succession they are classified into topographic, erosion, deposit, elevation and subsidence, edaphic, climatic, biotic and "ecesic causes," under which later name aggregation, migration, ecesis, competition, and invasion are cited. It would seem faulty, in nomenclature at least, to group ecesis under ecesic causes as a branch. In the way of innovations of nomenclature Mr. Clements has no equal, and the present volume is rich in this respect.

Classification is prominently discussed. Plant communities are classified by "seral" and climax units, the former being the dynamic phases of development, the latter a static condition. The latter, the climax units, are classified besides in those classes with which we have been familiar, namely, *associations, consociations* (characterized by a single dominant species), *societies* (within an association), into *clans,* local aggregations of secondary species within the preceding units. Seral, or developmental units, are named analogously to the climax units, the *associes, consocies, colony,* the difference from the climax units being merely their temporary character. The colony is an initial community of two or more species, resembling the clan in the limited size. *Family* is reserved for a group of individuals of one species.

What will interest foresters particularly is the part reciting from various sources the climax formations of North America.

A discussion of the need of geological, as well as meteorological, changes in the past as a basis for understanding present conditions, is followed by an attempt to trace the successions of plant formations through geological eras. An extensive bibliography, containing nearly 1,000 titles, concludes this most complete summary of present ecological knowledge.

B. E. F.

PERIODICAL LITERATURE

SILVICULTURE, PROTECTION, AND EXTENSION

American Fire Waste

The March number of the Annals of the American Academy of Political and Social Science is devoted to modern insurance problems, containing twenty-two articles on this subject, each written by an expert. Among these is one on American Fire Waste and Its Prevention, by Franklin H. Wentworth, secretary-treasurer of the National Fire Protection Association. Some startling statistical data are plainly put in the article. The fire waste in the United States and Canada is roughly ten times as much per person as in Europe—which may be partly accounted for by Europe's greater population and the greater number of wooden buildings in America.

The American annual fire waste is $3 per capita, or, with an average family of five (father, mother, and three children), means an annual tax of $15 per family. The annual loss from fires in the United States and Canada for the past ten years has averaged $230,000,000. The author tersely says: "We are the most careless people with matches on the face of the earth. In Europe, if you want matches, you have to go where they are kept. In America matches are everywhere—on our bureaus, in our desk drawers, on the mantelpieces, library tables, in all our old waistcoat pockets in the closets. If we wake up in the middle of the night and reach out and can't find a match, we feel insulted! And yet every match is a potential conflagration. Fire from a single match may burn a whole city."

Mr. Wentworth urges as a remedy (1) the construction of stone, concrete, and brick buildings, with metal window frames and wired glass. He is strongly against wooden buildings in cities, and especially condemns the wooden shingle, which has been the cause of considerable discussion, pro and con, in lumber journals for several years past. (2) Revision of our building codes. (3) Frequent and rigid fire inspection. (4) Placing responsibility.

What may serve as a fire slogan is stated by the author: "Nearly every fire is the result of some carelessness; and the careless man must be held up to public criticism as a man who has picked the pockets of the rest of us, because that is what it is in the final analysis."

The author does not make mention of forest fires anywhere, nor is it clear whether in his fire statistics he includes forest fire losses or not. J. D. G.

American Fire Waste and Its Prevention. Annals of the American Academy of Political and Social Science, March, 1917, pp. 163–171.

Forest Fire Insurance in Finland

In 1914 the Mutual Insurance Company, Sampo in Aabo, Finland, started a department for forest fire insurance. This department has at present forests insured to a value of 85,000,000 marks. In foreign countries, especially Norway, the forest owners have very successfully established their own insurance associations, and, with the Norwegian organization as a model, the forest association, Topio, decided in 1915 to organize the Finnish Forest Owners' Mutual Forest Fire Insurance Association. To cover expenses, 11,000 marks were guaranteed. Only to organize the Finnish Forest Owners' Mutual Forest Fire Insurance covers damage on forests and forest products. The membership lasts for five years, and if no written notice to the contrary is given before August 1 of the fifth year the insurance is regarded renewed for the next five-year period. The management consists of an advisory council of nine members of the association, with six substitutes, and three directors, with three substitutes, these chosen from the advisory board, elected for three years. There are three classes of insurance: (1) On small timber up to 18 c.m., d.b.h.; (2) on large timber above 18 c.m., d.b.h., and (3) on forests as a whole. The country is divided into two districts with regard to premiums to be paid, the first one consisting of the four coastal provinces, and the second district covering the rest of the country. An entrance tax of ½ per mille is paid for each insurance, and the premiums range from .8 to 1.75 per mille, with various discounts and increases of tariff. In order to make the damage appraisals easier, the insured forests will be divided into smaller lots, each separately valued and mapped. Appraisals are done, if required by any of the parties, by three experienced, uninterested men. The same day that the "Forest Owners' Mutual" was established, June 8, 1916, forests to a value of 60,000,000 marks were insured, and during

the next fortnight this amount was increased to 70,000,000 marks, in spite of the fact that another insurance company already existed.

O. N.

Skogsvårds Föreningens Tidskrift, August, 1916, pp. 625–8.

Fresh or Stored Forest Seed?

A Swedish forester, by the high-sounding name of Goethe, not a professional, but having had twenty years' experience in seed collection and forest cultivation, defies the common idea that artificially reproduced forests are of the same nature as the forests secured by natural regeneration. That the origin and careless handling of the seeds (as, *e. g.,* too high temperature during the cleaning processes, etc.) may cause the degeneration of many artificially reproduced forests is without doubt, but the length of time during which the seeds were stored is of more importance. Especially the quality of pines is influenced by long storage of the seed. But plants and stands of spruce have been found to be of high quality in spite of using old seed, even seed that had started to sprout before it was sown. This claim is based on experience, both in nurseries and in 10 to 15 year old stands.

O. N.

Skogsvårds Föreningens Tidskrift, June-July, 1916, p. 565.

Railroad Fire Protection in Sweden

On request of the Swedish "Riksdag," a committee was appointed to make proposals for a new forest fire protection law. This committee has given special consideration to forest fires caused by railroads.

Forest fire danger occurs with two maxima—one quite early in the spring, the other in the middle of the summer. In the spring ground fires occur mostly, while damage in the summer is caused by both ground and crown fires.

There is nothing new in the propositions. The various known methods are discussed as to their effectiveness and cost. Among these there are regulations as regards patrols, spark arresters, and care in stoking locomotives, as regards removal of inflammable material from and near the right of way, or the establishment of protective belts or varying width, according to grade, height of ballast and exposure of

soil. It is stated that railroad fires start usually within a distance of 25 yards, only rarely as far as 50 yards from the track. Cleared fire guards, which must be kept free from inflammable material or cultivated, are also used. Stone fences are cited as most effective. A considerable discussion on the use of isolating belts, which are now and then used in Germany, but not yet in Sweden, leads to the conclusion that such would be mostly too expensive to create and maintain, the damage by fire being less than the expenditure.

Such belts should consist of forest growth to intercept the burning embers. The one interesting statement is made that, contrary to usual belief, conifers are better adapted for this fire screen than deciduous-leaved trees, which, when the foliage is dry, are inclined to spread fires; an open stand of conifers, in which dry branches are removed, is most effective. Such belts are to be planted 30 or 40 yards from the right of way; the expense the committee proposes to charge to the railroads. They are to be managed under short rotations for pit props, pulpwood, poles, posts, and fuel wood.

O. N.

Skogsvårds Fōreningens Tidskrift, January, 1917, pp. 69–76.

Seeds of Life Duration

The laws of the life duration of seeds at various degrees of temperature is of considerable importance in forestry, particularly in determining a safe temperature to employ in kiln drying the fruits of forest trees prior to the extraction of seed and the duration of storage. Foresters have come to a general understanding that temperature in the extraction of seed should be gauged with extreme care. Haack recommends a constant temperature of 122 degrees F. as the permissible heat for green cones, and if the cones are dry when gathered or have been thoroughly cured a temperature of 131 degrees F. is permissible. Recent investigations appear to prove that the seeds of most species will withstand a considerably higher temperature for several hours, provided they have been sufficiently dried beforehand.

In the interesting paper by J. F. Groves the author gives a very complete historical review of previous investigations that have been made on the laws of the life duration of seeds at high temperatures. Special apparatus was devised to obtain constant temperatures and the

seeds were sterilized after heating. The germinating dishes were also sterilized and care used in planting. By this practice the germinating seeds were kept free from fungal growth for several weeks.

The results of the author's studies on seeds heated at variable lengths of time at 87.5 degrees C. show that there is a gradual decrease in the percentage of germination with increased time of heating. Also after the delayed seeds germinated their growth was much slower than that of unheated seeds. The effects produced by heating were similar to those produced by the storage of seeds at room temperature, thus indicating a similar change in the seed in both cases.

In these studies the author selected the time required to kill 75 per cent of the seed at the end point. It was found that there is a definite relation between temperature and the time of exposure necessary for killing 75 per cent of the seed. By determining the time required to kill seeds at any two definite temperatures, the time required for killing seeds at any other temperature was calculated from Lepeschkin's formula, $T = a—b \log Z$, in which Z is the time in minutes and a and b are constants.

The author states that if the loss of viability of seeds during storage is a matter of the coagulation of cell proteins of the embryo, this time-temperature formula for the coagulation of proteins should be applicable as a temperature-life duration formula for seeds.

A rather close agreement was found between calculated values by means of Lepeschkin's formula and those found by experiment, thus indicating that the time-temperature formula for the coagulation of protein can be applied as a temperature-life duration formula for seeds.

The article throws light on the nature of the processes in the loss of viability of seeds in storage and suggests the possibility of the quantitative measurement of various storage conditions and their significance, especially moisture and temperature, upon the longevity of seeds. J. W. T.

Botanical Gazette, March, 1917, pp. 169–89.

American Species in Germany

An interesting account is given by Illick of the introduction of American tree species into Germany, from which it appears that as early as 1566 the eastern arborvitae was introduced and during the seventeenth century, black locust, bald cypress, tulip tree, red cedar, and balsam fir, found their way

across the ocean. Black and white spruce was planted in 1700, white pine in 1705, red oak in 1740, and now nearly all American species are represented, at least in parks.

For forestry purposes, red oak, white pine, and Douglas fir take first rank. Red oak, recommended for its rapid growth, good wood and resistance to disease, has now the widest distribution of any American hardwood; a plantation of 450 acres from 1 to 90 years of age, in Baden, is mentioned.

A white pine plantation of Trippstadt, Bavaria, and started in 1794, among which specimens of 25 to 35 inches are found in thrifty condition. A 140-acre tract, in the city forest of Heidelberg, is planted to white pine, ranging from 2 to 65 years of age. A sample plot in this stand, established in 1888, using 2,750 two-year-old seedlings per acre, had in 20 years from planting reached an average height of 26.5 feet and a volume of 53 cords—an annual increment of 2.4 cords per acre! And in the last five years the rate had been 3.8 cords.

Douglas fir, not introduced until 1827, has shown itself the most desirable of all species so far as experience has gone. Espcially in height growth it excels all German conifers; it may in eighteen years attain a height of 56 feet, and in 53 years of 83 feet.

A mixed stand of Douglas fir and Norway spruce was planted with three-year-olds of fir and two-year-olds of spruce, spaced four feet, at a cost of $4.56 per acre. In sixteen years it had made 34 cords of fir and 7 cords of spruce. Five years later the fir measured 43 cords, the spruce only 6¾, being crowded out. The height of the two species then was 45 and 32 feet, respectively. The ready recovery from damage due to many adventitious buds is also mentioned.

B. E. F.

American Trees in Germany. Forest Leaves, December, 1916, pp. 184–5.

Optima of Thinnings

A valuable contribution by E. Mer in regard to the most satisfactory degree of thinning is of interest to us, more by the manner of using the data than for the data themselves. The careful analysis of the data brings out strikingly the fact that the results of thinning practice are complicated and according to the point of view of varying import. The study is also of interest as coming from a French source. The French have not practiced thin-

ning very extensively, and discussions on results of various degrees of thinning have also been rare.

The data were secured from a stand of 50 to 60 year-old fir on two sample plots first, to which, sixteen years later, a third one was added. Plots *A* and *B* were thinned in 1886 and 1899, but to secure data indicating an optimum at least a third plot needed to be thinned to a different degree, and this was done in 1902. At that time, and again in 1911, the measurements from all three plots, with proper allowances for the added plot, were secured and tabulated for easy comparison. The thinnings in 1902 removed 29, 25 and 23 per cent of volume, respectively, from the three plots, *A*, *B* and *C*. Before the 1902 thinning there were in *A* much fewer (20 per cent less) trees than in *B*, but a slightly larger volume and circumference (diameter) of average tree. Owing to the deficiency in tree numbers, however, both basal area and total volume were smaller than in *B*. The 29 per cent thinning in *A* removes a larger number of trees, yet a smaller absolute volume than the 25 per cent thinning in *B*, and also leaves a smaller total volume; but the volume of the average tree in *A* is increased (by the removal of so many inferior trees).

The changes in nine years following the 1902 thinning show the circumference of the average tree in *A* to have increased by only 3 centimeters and in *B* by 5 centimeters, but the volume of the average tree has increased .093 c.m. in *A* as against only .063 c.m. in *B*; yet the total basal area, which was smaller before in *A*, has remained so, although its increment is slightly larger than in *B*.

The *absolute* volume and value production in *A* has, however, remained behind; on the contrary, the *percentic* production, relative to the growing stock, is fully 2 per cent larger in *A*, showing of how little value the percentic statement is.

The conclusion is that the inferiority in production of *A* is due not to a lack of increment on the trees remaining, but to their deficient number; the thinning was too severe.

Another interesting showing results, namely, that while the total average annual volume increment in *A* is smaller than in *B* by fully 10 per cent, the value increment in the two cases is nearly the same. Percentically, however, both volume and value increment are superior in *A*, which might be considered an argument for the severer thinning.

A similar comparison is made with the results in plot *C*, thinned by 23 per cent. Here, as in *A*, the average annual product in volume

and value is much less than in *B*, but from the opposite reason, namely, due to inferior size of trees, with larger numbers. The total increment in the nine years was greater in *B* than in *C*, but again the percentic production was 1 per cent smaller; the position of *C* in percentic relation lies between *A* and *B*.

The consequence of an insufficient thinning can then in this respect be inverse to that of a too severe thinning. In the latter case the lower product has reference more to volume than to value, since it has to do with larger-sized trees, which command, per unit of volume, a higher price.

While on the whole the annual average increment, both in volume the value, in *C* is superior to *A* and *B*, this does not necessarily imply the same relation at all times; an enlarged volume may not produce a similar value increment.

In examining six phases of development, the difference in volume was four times found in favor of *B*, but the difference in value five times to the advantage of *A;* only in two of the five cases was the difference of volume and value credited to the same plot—once to *A*, once to *B*—showing that oscillations in volume and value production at various stages of development as a consequence of thinning take place.

From these comparisons it can be deduced that if the 29 per cent thinning was too severe, the 23 per cent is too moderate, and the 25 per cent more advantageous, the optimum limit. The author advocates such small experiments to be undertaken under the varying conditions by the practitioners, when in a few years the proper degree can be determined. Altogether, while experiment stations have their value in developing principles, individualism in research, the author thinks, would be of more immediate practical use. Especially in France, where forest property is largely private, lack of initiative on the part of forest owners is reprehensible. "Is it not strange that the owners of 15,000,000 acres of woods believe they can dispense with acquiring technical knowledge, and that, within nearly a century, the number of French students at the forest school has only been forty-five in the average per semester?" B. E. F.

Recherche de la limite optima d'intensité dans les éclaircies. Revue des Eaux et Fôrets, February, March, 1917, pp. 33–43, 65–72.

UTILIZATION, MARKET, AND TECHNOLOGY

By-Products of the Forests and National Defense

In the March issue of the Scientific Monthly, in the Progress of Science Department, the value of by-products of the forest as related to national defense is most forcibly emphasized by the results of studies carried to a successful completion at the United States Forest Products Laboratory at Madison, Wis. Powder for war munitions, disinfectants for protection against contagious diseases, and artificial silk for clothing are a few such products. Charcoal is essential for black powder; acetone, derived from hardwood distillation, is used in the manufacture of nitrocellulose powder; pure wood alcohol for formaldehyde as a disinfectant; wood cellulose is made into cloth or artificial silk, and paper garments are reported as being extensively used by some of the European combatants. The demand for black walnut for gun stocks has greatly increased; even willow for wooden legs was never so much needed, and large quantities of spruce are being used not only in the United States but exported for use in the manufacture of aeroplanes. And in this connection, in the recent reports of the Paris Academy of Sciences on the Loutreill Foundation, it is stated that among the many grants made by the council of this Foundation is one of 4,000 francs to the Association of Arts and Trades to Louis Blaringhem for the creation of a typical collection for the determination and classification of the woods used in the aeronautic industry. J. D. G.

By-Products of the Forests. The Scientific Monthly, March, 1917, pp. 286–288.

MENSURATION, FINANCE, AND MANAGEMENT

Progress in Mapping the Earth

In a recent issue of the Scientific Monthly is given the gist of an address by Edward A. Reeves before the Geographical Section of the 1916 meeting of the British Association for the Advancement of Science on the progress in the mapping of the earth since 1860. As showing the great progress that has been made, it is pointed out that in the Eastern Hemisphere in 1860, outside the continent of Europe, the only country where any mapping, based on triangulation, had been done was India. In Europe,

France, the British Isles, Germany, Austria, Italy, Russia, Switzerland, Denmark, the Netherlands, and Scandanavia had made a good beginning with government maps, based on trigonometrical surveys, but these were not completed. At that date in the Western Hemisphere little or no triangulation had been done, although the United States Coast and Geodetic Survey had made a good start on the coasts. About the only serious attempts previous to 1860 in the Americas were La Condamine's attempt in 1736 to measure an arc of the Meridian in South America and the surveys of Mason and Dixon, later to become famous in history. Such mapping as had been done along the Atlantic seaboard could hardly be considered much more "than route traversing and sketching."

As an index of the progress made from 1860 to 1916, at that date the parts of the earth entirely unsurveyed and unmapped represented one-half of the earth's surface, whereas in 1916 there remains only about one-seventh. The following comparative table is quoted as of interest:

	1860		1916	
	Sq. Stat. Miles.	*Proportion to Whole*	*Sq. Stat. Miles*	*Proportion to Whole*
Mapped from accurate topographical surveys based on triangulation or rigorous traverses................	1,957,755	= 0.0326 or roughly 1/30	8,897,238	= 0.1482 or roughly 1/7
Mapped from less reliable surveys, chiefly non-topographical................	2,017,641	= 0.0336 or roughly 1/30	5,178,008	= 0.0866 or just over ½
Mapped from route traverse and sketches............	25,024,360	= 0.4170 or roughly 2/5	37,550,552	= 0.6258 or little less than 2/3
Entirely unsurveyed and unmapped................	30,997,054	= 0.5166 or just over ½	8,350,794	= 0.1391 or little less than 1/7

Progress in the Mapping of the Earth. The Scientific Monthly, November, 1916, pp. 515–520.

Swedish State Forest Accounts

In the Swedish State forest service a committee of accounts makes monthly statements of the expenditures and incomes of the State forest service in detail. A statement for the first ten months of 1916 of the State property is as follows:

Incomes: State forest administration, \$6,810,373; State farms, \$791,419; sales of land, etc., \$323,078; total income, \$7,278,714. Dur-

ing the year some incomes from sales of land, etc., occurred, which are not counted in the final income, as they will be used for future purchases of land.

Expenditures: General administration, \$48,646; State forest service, \$2,108,930; State farm lands, \$33,972; total expenditures, \$2,191,-548—a *net* income of \$5,087,166.

This, from an area of around 20,000,000 acres, would approach 30 cents per acre per year; but since at least 70 per cent of this area is not really producing, the net yield may be assumed as nearer one dollar from productive area.

O. N.

Skogsvårds Föreningens Tidskrift, November, 1916, pp. 733–7.

Conservation and Economic Theory

In a thoughtful paper before the American Institute of Mining Engineers Dr. Richard T. Ely, professor of economics in the University of Wisconsin, claims that the chief rôle in conservation belongs to the political economist, because in the end "wise conservation means wise property relations." Conservation, the author explains, has to deal not only with preservation of natural resources, which must often take the form of public ownership and management, and with improvement of our natural inheritance, but also with production and with justice in distribution, and here property and contract and their social theory are involved. There are, then, two orders of inquiry involved in conservation, namely, that falling within the broad field of natural sciences; the other within the field of economic thought and of the too much neglected question of property relations. "When we decide upon what we want so far as property relations are concerned, engineers and other technical men will be able to carry out the desired policy, and political science must be called on for aid." The author gives examples from various fields, and especially the irrigation policy in the United States is highly illustrative.

After showing that "waste" is a relative term, the striking thesis is discussed that "the conservation of human resources limits the conservation of natural resources." "How shall we balance the interests of the present and the future?" is the problem.

In attempting to find principles upon which conservation policies

should be based, a classification of resources from the standpoint of their possible exhaustion is first needed, and one, resembling that long ago proposed by the reviewer, is quoted from an article by Prof. L. C. Gray, as follows:

1. Resources which exist in such abundance that there is no apparent necessity for economy, either in present or future. For instance, water in some localities.

2. Resources which will probably become scarce in the remote future, although so abundant as to have no market value in the present. For instance, building stone and sand in some localities.

3. Resources which have a present scarcity:

(*a*) Not exhaustible through normal use: Water powers.

(*b*) Necessarily exhausted through use, and nonrestorable after exhaustion: Mineral deposits.

(*c*) Necessarily exhausted through use, but restorable: Forest, fish.

(*d*) Exhaustible in a given locality, but restorable through the employment of other resources of a different kind or of similar resources in different locations: Agricultural land.

The suggestion is thrown out that the difference between the present and future, to the individual, is represented by interest, and, in the case of forests, the discount of the future may be made at the lowest possible rate paid by a prosperous State, say 2 per cent. Yet in reality the interest rate cuts no figure, for essential resources should be conservatively used for the longest time, and that time is an unknown quantity. Private and common interest are contrasted. Private conservation of resources may, in part, be secured by moral education, which secures increased regard for the interest in the future, yet enlightened self-interest, especially of corporations, "has a greater rôle to play in conservation than is generally understood," but here the rate of interest does set a limit. The sinking tendency of the interest rate may increase the degree of conservation due to private initiative. Finally, "when it is possible and as a general principle, social burdens should be socially diffused and socially borne." Labor legislation is cited in illustration. In the case of the farmer, the private and the social interest coincide satisfactorily; the opposite may be true with the railroads, for we regulate these to such an extent as to remove a large part of the satisfaction and benefits of private property. So if we are obliged to regulate very far private property in the interest of conservation, we have a strong ground for public ownership; as in the case of forests.

Private property yields the best results socially, when the social benefits accrue largely spontaneously or by slight application of force, or by single public acts occurring at considerable intervals, or finally,

"private property may yield excellent results also when . . . a continuous and considerable application of force may be needed to bring its management up to a socially established ethical level," but in proportion as the pressure must be increased, the advantages of public property increase. That does not mean suppression of private ownership of land, capital and private initiative: the growth of the police power may suffice to regulate private management. "In the case of forests, the civilized world now recognizes a large amount of public ownership necessary;" mineral treasures and shores of harbors similarly.

"Conservation, then, necessarily means more public ownership, more public business; this means a demand for better government; and this means giving men a real career in the public service."

In conclusion, the author expresses the conviction that only through commissions can conservation be put in practice, only general principles being laid down by legislators. B. E. F.

Conservation and Economic Theory. Transactions of the American Institute of Mining Engineers, Vol. LIV, 1917, pp. 458–73.

French Forestry After War

French foresters are beginning to discuss the lessons which the war has taught and the problems which will come to them in the recuperation of the devastated forests in the war zone and elsewhere.

Demorlaine points out the essential need of re-establishing immediately and rapidly the destroyed wood capital and the necessity of assisting private owners in this with means and measures. Large wood reserves have been used up by all belligerents, and France especially, which could not, even before the war, supply itself fully with dimension material, will be in a precarious condition. Higher wood prices than ever are foreshadowed after the war, when reconstruction begins. This and the opportunity of remunerative use of money capital elsewhere will have the tendency of inducing further inconsiderate reduction of growing stock, and calls for government interference, restriction and expropriation. The assistance to private owners can be of two kinds—immediate regulation of indemnities due the owners for wood furnished during the war, in order to provide them with funds for reforestation; in other cases, to provide the necessary labor. There seems to be no uniformity and some injustices perpetrated in requis-

tioning wood and in adjudicating damages. It is pointed out that promptness is indispensable in ascertaining the damage particularly. Moreover, delay in reforesting will deteriorate the soil through weeds and shrub growth; in the coppice neglected stocks will decay. The forest service will have to supervise the use of the indemnity funds for restoration. The parliament has already such legislation under discussion.

As regards the furnishing of labor, this principle of using the army is recognized in farm work, but not as regards forest work. This needs to be changed. At present prisoners (who are now employed on roads) may be used for reforestation purposes and nursery work.

L. Pardé has several articles on the teachings of the war. He bemoans the lack of knowledge in logging methods, utilization and wood technology on the part of the forest officers, due to the fact that, the timber being sold on the stump, they had no need of that knowledge; so that, being called upon by the army requirements to themselves attending to furnishing specified material, they were incompetent to do so satisfactorily. It is desirable after the war to eradicate this ignorance, and also practice, at least to some extent, direct exploitation on their own account.

Lack of acquaintance with a variety of forest conditions that are met in the country is also charged against the foresters, who should be given opportunity to visit different localities and eradicate one-sidedness and increase their silvicultural knowledge.

Examples of the variety of silvicultural operations in different localities (and even in the same forest) are given. Some of these may be due to well-reasoned observations, others to the mere routine of inherited and unreasoned processes. Broader knowledge of these various practices may lead to eradication of the undesirable one. Since labor will be scarce after the war, it is essential to reduce it to mere necessities.

Another lack of knowledge complained of is that the foresters know nothing of foreign woods which must be imported. It was considered a mania of the few who occupied themselves with this dendrological study. The war has taught the most skeptic that the exotic woods are of great interest.

The fact that improvement feelings and first thinnings have been neglected in the broadleaf woods for lack of labor the author considers more detrimental than the overdraft to supply the army; at least

for railroad purposes—the author seems to act as an agent for railroad supplies—the fellings have proceeded normally, according to plans, and otherwise without trouble; even the removal of underwood, brambles, etc., was properly attended to. There are, however, some badly managed forests; the author seems to charge this to too long working plans which nobody reads, instead of laying down a few principles, leaving to the initiative of the manager the detail of execution. A working plans bureau is proposed, perhaps under a special inspector-general, using, however, the knowledge of resident managers of experience.

The forest maps come in for criticism, not giving any surroundings, roads of different character, and villages, stations, or other occupied places. The absence of a geological map is regretted. Lack of uniformity and propriety in cruising, classifying and valuing the fellings is astonishing the author, when he found greatest differences in this respect in neighboring forests belonging to two different conservations. Gross errors are undoubtedly underlying these differences. The lack of knowledge in this respect is again charged to the habit of selling on the stump, and a change in this respect after the war is declared necessary. B. E. F.

Revue des Eaux et Fôrets, December, 1916, pp. 349–53, January, February, March, 1917, pp. 12–14, 44–46, 73–76.

Finance in India

The Indian Forester quotes from *The Indiaman* an interesting criticism of Indian forest finance. After showing that State Forest in British India covers about 250,000 square miles, "or more than one-fifth of the total area under English administration," and after admitting that "the first duty of the administration is to keep the forest in existence," it is argued that the second duty is to make a success financially, and "the third duty is to raise this net revenue to the maximum, and here the administration has, in our opinion, fallen seriously behind; as will appear later on, we make this charge, not against the technical officers, but against the superior administration of India as a whole."

The writer places the present revenue at about $5,000,000, which amounts to about 4 cents per acre administered. After showing possibilities of greater increased revenue, a strong plea is made for more

capital, for the establishment of better stands, for communications, for market studies, and for more thorough research.

T. S. W., Jr.

Development of Indian Forests. Indian Forester, January, 1917, pp. 30–34.

Grazing in India

Those specializing on grazing may be interested in C. A. Malcolm's statement on grazing problems in the Central Provinces. As a result of past experiences, the Indian Forest Service has adopted a broader viewpoint in regard to the alleged damages from grazing, because they have found "that in the closed areas the young teak seedlings get choked in the rains, in the high grass, or destroyed by fierce fires, such as occur during hot weather, when fire conservancy is unsuccessful. In grazed areas the grass is kept low, and if a fire runs through it the seedlings generally escape with a scorching." In theory sheeps, goats and buffalo are considered undesirable, and they conclude that cows, bullocks and bulls "can be admitted without detriment to the tree growth."

It is interesting to note that lower rates are prescribed for stock that is used in *agriculture* than for mere range cattle. The commercial fees range from 16 cents to 34 cents per cow per year, "and the fees for agricultural cattle from 3 to 20 cents per year."

T. S. W., Jr.

Some Problems in Connection with Grazing in the Central Provinces. Indian Forester, January, 1917, pp. 10–15.

STATISTICS AND HISTORY

Finland Lumber Export

An important step toward placing the Finnish lumber export business on a sound basis has been made by the lumber interests of Finland. The Finnish Sawmill Selling Union has been formed recently to handle the foreign trade, and now represents 90 per cent of the sawmills engaged in the export lumber business. Previous to the war, the lumber export trade, due to lack of cooperation between sawmills, was in an unsatisfactory condition, and the profits were small. The new organization hopes to remedy this situation. The domestic trade will be handled by each sawmill, as in the past. The former condition of the Finnish lumber industry is

comparable to that now existing in this country, but as yet little has been done to remedy it. Lumbermen in the United States hoped for the passage of the Webb bill, which was before the last Congress. This would have removed certain restrictions now existing which relate to foreign sales corporations, and would have freed the lumbermen exporters of other goods from possible prosecution as "operating in restraint of trade." The trade-marking of lumber has been practiced in Finland for some years, and special markets have been created for special brands. The policy of the new sales organization will be to continue to sell the product of each mill under its own trademark. It is reported that large stocks of lumber are being accumulated in Finland for post-bellum export, the new selling organization being sufficiently strong financially to hold stocks until a favorable market is secured. This will tend to stabilize the market and prevent sudden fluctuations in price. At the present time 70 per cent of the value of Finnish exports are represented by forest products.

American Lumberman, March 17, 1971, p. 28.

Wages in Logging

A rather novel method of labor payment on a logging operation is reported from the camps of the Inman-Ponken Logging Company, near Kelso, Washington. This company no longer pays straight daily wages to the yarding or loading crews, but has adopted a system of payment on the thousand-foot output basis. The schedule of prices paid to the crew members per M feet is as follows: *Yarding crew*—One hook-tender, 9 cents; one second rigging man, 6; one signal boy, 4; 1 road engineer, 6½; one head rigging man, 6½; one chaser (yarder), 6; one chaser (roader), 6; two swampers, 4½, and one yarding engineer, 7 cents. *Loading crew*—One engineer, 7 cents; one head loader, 7, and one second loader, 6 cents.

Where oil is used as fuel, a fireman is not furnished. The engineer must get up steam in the morning and make running repairs on his engine. Where a fireman is furnished, a reduction of one-half of 1 per cent per thousand is made in the pay of engineers. All rollways are built at the expense of the company; all donkey engines are set, ready to put out lines; high leads are put up, and swing and road engines set before the yarding and loading crews begin. Yarding

crews put out and change lines and move donkey engines from one end of a rollway to the other on their own time; put in all "fore and afters," and perform all other work necessary to begin operations after rollways are built and donkey engines are set. In case a donkey crew stops logging to change donkeys or to do any work to be done by them, and if one or more of the crew lays off for any cause, the company may put substitutes in their places and charge wages of said substitutes to the crew. In case no substitute is furnished, the man who quits forfeits one day's pay to the crew doing the work he was entitled to do that day. No logs shall be credited to any crew or any member of any crew until the logs are on cars in the switch yard and have been scaled. In case a man quits, is discharged, or laid off, he forfeits all rights to all logs on the rollway. Members of donkey crews working until the camp shuts down or until the end of the season are entitled to pay for all logs on the rollway, even though these logs are loaded after the donkey crew quits and are paid off. In case a donkey crew has an extra hard "show," the rate is raised on that "show." The company reserves the right to pay off all men working less than one month, by the hour.

Timberman, March, 1917, p. 48B.

Forestry in Great Britain

In his presidential address before the Scottish Arboricultural Society, Sir Andrew Agnew takes a more cheerful view of forestry in Great Britain "than we have been able to do for a long time." Even in these war times, and, perhaps, on account of them, and finding out the awkwardness of relying on imports, the government has appointed a special committee to deal with the subject of reforesting waste lands—apparently taking the matter out of the hands of the development committee, one of the many committees which have dabbled with the problem. The necessity of a special forest department is urged.

The year before the war the importation of wood materials exceeded $200,000,000, while there are some 12,000,000 acres of waste land, which may bring 25 to 50 cents from grazing, that could be used for timber growth. The use of the returned soldiers for this planting is suggested; this in connection with the proposed farm colonies and the repopulation of the Scotch Highlands.

A concrete plan for cooperation between the State and private owners in this reforestation is brought forward, with a view of expediting progress, by Captain Gammel. It involves tax release for the forested land until an income tax can be levied, the planting to be done by the owner with money loaned to him by the government at 2½ per cent, repayable by annual installments after forty years, with compound interest until paid, the government having a lien on the forest property, but only on that. An option to pay off the government loan at any time is also provided. With $20 allowance per acre for planting cost on a 1,000-acre proposition, in forty years, the cost will have accumulated to around $54,000, when thinnings will take care of the interest rate and administration cost.

In case of trouble, the government may have to take the property over and then pay for the land its original rent value, which might be $20,000. A financial calculation, with an eighty-year rotation, returns being $500 per acre, leaves a balance credit of around $68,000 to the owner. In case of failure of the crop, it is suggested that, if it occurs within, say, ten years, the government expert under whose advice the plantation was made was at fault, and hence the government must make good. If the failure, a partial one, occurs later, the two parties are to divide the loss.

The war conditions are also responsible for recognition of the fact that mine props can be supplied by domestic woods, which can be grown in fifteen to eighteen years. The author recommends four species for the purpose—the Black poplar, Douglas fir, Sitka spruce, and Japanese larch, which latter, in a ten-year plantation, made 4 to 8-inch diameters at 5.5 feet from the ground. "Unless the demand for props can be met by a constant supply, the consumers will be driven back to the oversea trade, with the result that the excellent market which has now been established for home-grown pitwood will speedily revert to the pre-war standard of unremunerative inanition."

From a financial statement of the expenditures from the Development Fund and Forestry, it appears that in the six years of its existence loans and grants to the amount of $1,200,000 were made, of which, for reforestation schemes, $550,000; for land purchases, $125,000; for demonstration area in the Forest of Dean, $85,000, and for educational purposes, support of forestry associations, research and experiments, $430,000.

In this connection we must refer to a very humorous, but at the

same time most scathing and sarcastic, account of the doings of the Development Commission, appearing in the *Timber Trades Journal,* purporting to be the commission's report for the year 1950, by which time every town was supposed to have secured a forest school, but reforestation schemes or other use of the education were frowned upon. There are now more than a dozen schools teaching forestry.

Transactions of the Royal Scottish Arboricultural Society, January, 1917, pp. 1–13.

SOIL, WATER, AND CLIMATE

Woodland Succession from Soil Exhaustion

Succession from soil exhaustion implies an anti-climax or going back. The ordinary direction of succession is forward. Thus succession following a forest fire is usually due to soil improvement from the reaction of the vegetation itself. The direction of development in vegetation is usually toward the highest type of mesophytism possible under the prevailing climatic conditions. This is progressive development from bare areas to climax. Clements and others have recently questioned whether regressive succession exists in the same sense as progressive succession. Nielsson, Cajander, Cowles, Moss, and others, in their discussion of this subject, infer that retrogression is usually due to local conditions bringing about the destruction of a particular stage in the succession, but in all cases this does not appear to be true. This destruction often occurs again and again at any stage of succession in many separate places, and as a result there is, over the whole area, a mosaic of the so-called "regressive" areas with the progressive areas.

Succession is fundamentally a process of development. Clements contends that in the so-called regressive succession there are no processes of development at all. They are rather examples of the initiation of progressive development in consequence of destruction.

There are, no doubt, many instances of the change of a forest vegetation into a lower type of vegetation. Such is the conversion of the forest into scrub, heath, grass-land, or swamp. Evidence of the change of forest into grass-land or heath is obtained wherever lumbering, grazing, and cultivation have been practiced for long periods. There is no doubt, however, but the usual conversion of forest to

scrub or grass-land is when artificial agencies are at work. Warming goes so far as to say: "Were the human race to die out the grass-lands of the lowlands of northern Europe would be changed back to forest, their condition before the interference of man."

In the paper by E. A. Woodruff-Peacock the writer contends that woodland succession, including the natural degeneration of forest to scrub or grass-land and the change from one species to another, is primarily due to soil exhaustion. He states that species appear on sites at definite historical periods. Thus in Lincolnshire, England, Roman times brought in the beech and the Neolithic times the ash and elm, as demonstrated by peat deposits. He states that during the eighteenth century the great oak woods of north Lincolnshire disappeared and its place was taken very largely by ash and elm. In this case soil exhaustion is assigned as the cause of the passing of one species and the coming in of another.

The author states that when, in the progress of time, the seedlings of a long predominant species fall just as they become wholly dependent on the soil for their nourishment, it is an indication that they are passing from that particular soil for at least a succession period. It is emphasized that Lincolnshire was covered with oaks in the seventeenth and early eighteenth centuries and that there are still left a few old standards, but no seedlings or young trees. When the northern ancestors overran Lincolnshire in 400-1000 A. D. the beech was already there in abundance. Since then the soil has had time to become beech-sick, as exemplified in its decreasing distribution. He observes that the reproduction among the old beeches that still survive is not beech at all but ash and to a lesser extent, wych elm. The author's conclusion from the study of historical evidence is soil exhaustion for a given species is evidenced:

(1) When the germinating seeds fail to survive on the soil.

(2) When there are present in abundance self-sown, healthy young trees of another species.

(3) When a wood begins to show evidence of decline and a gradual thinning of the stand, and when, before the end, it becomes park-like unless other species come in to occupy the open places.

(4) When the woodland for a time is taken by its peculiar under species and scrub, although in its mid-vigor it easily maintains itself against them.

Regarding the latter it is noted that the under species only persist

for a time after the departure of their betters. Scrub also in time finally gives place to something else. Grass-land of various classes follows woodland on the true clays; heathland on the limestones, and moorland on the sands and gravels.

The author raises the question: "Why should a pure wood of any species terminate except for two reasons, namely, soil exhaustion for the species or change of climate?" He admits that his reasoning for "woodland succession" from soil exhaustion is inconclusive in that it is difficult to distinguish it from succession due to change in climate. In the opinion of the reviewer the illustrations drawn and the arguments presented by the author are not at all convincing.

The trend of progressive succession is always toward the mixed forest and away from the pure stand. The climax type is seldom of a single species. Even were it proved that a single species, as illustrated in the beech or white pine, did in time exhaust the soil for that species (a condition which is as yet far from being proved) its chief importance in succession would be in stimulating a change from a pure to a mixed stand, not a change from one pure stand to another. When a mixture of several species has been attained, soil exhaustion for any one can have no possible effect in causing succession because the several species can continue shifting places and no two generations of the same species are likely to grow in exactly the same places in the stand.

J. W. T.

Quarterly Journal of Forestry, July, October, 1917, pp. 193–99, 253–63.

Grass and Ash Trees

That trees suffer when a stand becomes so open grasses are able to enter, is a well recognized principle in silviculture. Better growth in young trees is got when they are grown on land that is plowed or otherwise cultivated so that grasses and weeds are kept down. Even old trees suffer through the presence of grass on the forest floor. This is clearly shown when a middle-aged or mature stand is heavily thinned and the ground "grassed over."

All species are not alike sensitive to the destructive influences of grass. As a rule, conifers are less effected than hardwoods, though in the former the various cedars are more sensitive than pines.

Professor Somerville, the writer of the article under review, calls

attention to extensive researches in England made some years ago in an effort to show the effect of grass on fruit trees. In this investigation it was shown that the soil and climate are determining factors in the amount of injury from grass. Fruit trees make a much better fight against grass on deep, loamy soil in the west of England than on the gravel and chalk of Kent or Surrey. It is pointed out that fruit trees are often killed by grass; that recovery of health only occurs where the roots extend beyond the grassed area and that ground that gradually grasses over while the trees are growing is less harmful than when the grass is sown and comes on at once.

Forest trees were effected in the same way as fruit trees when grass was sown immediately after planting, but on light soil conifers were effected much less than fruit trees and some recovery occurred in time, whereas in the case of fruit trees the effect was intensified by time. The writer states that the injurious effect of grass was proved not to be due to:

(a) Interference with the circulation of atmospheric air in the soil.
(b) The amount of carbonic acid in the soil.
(c) Soil temperature.
(d) Food supply.
(e) Physical condition of the soil, or
(f) The micro-flora of the soil.

He states that it was found to be due to a substance produced by the grass roots, which acts as a poison to the roots of most trees. The evidence, however, from which the above conclusion is drawn is not presented in the article under review. The toxic substance is said to be easily destroyed by contact with air, which accounts for the fact that trees will make but poor growth on an old pasture while the turf from the pasture when torn up and decomposed greatly stimulates growth.

Ash and larch planted in 1912 on ground covered with grass showed in 1913 and 1914 that:

(1) The effect of the grass was evident at the close of the first season.

(2) The terminal bud often failed to mature and the foliage was stunted and short.

(3) The annual shoots were much shorter than those produced by trees on plots where the ground was kept bare.

(4) Considerable difference in effect was produced by various species of grass.

Experiments by the author near Oxford were as follows:

In the month of March, 1910, 123-year-old ash trees were planted at three-foot intervals and the ground kept bare from grass and weeds. On April 25, 1911, the area was divided into two equal parts and on one of them was sown a mixture of grass and clover. The other was kept clean. The table below shows the average height growth under the two conditions in 1911 and 1912:

	1911	1912	2 *Years*	*Average Height of Trees*
With grass	29	23	52	85
Without grass	38	48	86	122

Studies were also made on the effect of various kinds of grasses and other plants on the ash when grown in pots. Although the inference from this article is that toxic materials thrown off by the roots of the plant are a possible cause of the unfavorable growth of the trees when grown on grass plots the case has by no means as yet been proved. J. W. T.

Quarterly Journal of Forestry, July, 1917, pp. 212–18.

PERSONAL

At a meeting of the Oklahoma Academy of Sciences on December 1 and 2, 1916, Frank Rush, supervisor of the Wichita National Forest, read a paper on "The Past and Future of the Buffalo." At this meeting a committee was appointed to secure the passage of better laws in Oklahoma for the protection of wild life. Mr. Rush was made chairman of this committee.

William H. Kobbé, Yale Forest School, 1914, later of the Philippine Forest Service and of the Coconino National Forest, is now a successful oil-well owner and dealer at Tulsa, Oklahoma. A paper by him was presented at the January meeting in New York of the American Society of Mining Engineers.

A tour is being organized by the Bureau of University Travel for the Massachusetts Forestry Association for the coming summer. The tour will cover all the National Parks of the United States, as well as typical National Forests in each of the six western forest districts. It will start from Boston on June 28, and last forty-four days.

D. M. Lang, formerly lumberman in the Fourth District, has been transferred to the Southwest District and assigned to the office of silviculture in Albuquerque, New Mexico.

Ranger W. L. Scofield has been assigned to a study of brush disposal in the Southwestern District. At present he is conducting the work on the large sale areas on the Coconino National Forest.

Thomas P. Reid, scaler on the Tusayan National Forest, resigned on March 3 to accept a lucrative position as forester with the International Lumber Company of Minneapolis. Mr. Reid graduated at Yale (Academic) in 1911 and at the Yale forest school in 1913 and has had considerable experience in the Southwest where he made an enviable reputation as a Federal forest officer. He passed the scaler's examination in 1916 and has had charge of a large sale on the Tusayan Forest for the past two years.

Augustus Stanwood, who has been credited with the invention of using wood for paper manufacture, died recently in Brooklyn, New York.

One of the most noted practicing foresters, known in all parts of the world, Dr. Ulrich Meister, for more than forty years manager of the celebrated city forest of Zürich, Sihlwald, died on February 3, 1917, in his eightieth year. The son of a forester, he grew up in the woods and took naturally to the profession, one of the first to receive their education at the polytechnicum in Zürich, and then at Giessen, under Gustav Heyer, whose assistant he became in editing the forestry journal *Allgemeine Forestund Jagdzeitung*. In 1859, at the age of 21, he became a docent at the university, but after a year and an extensive travel through Germany he returned to Switzerland, and at the age of 26 became forest master at Zürich and a responsible member of the city council, and in 1875 manager of the Sihlwald. The volume, published in 1900, describing the history of the development of this remarkable forest, under working plans since 1680, is a worthy memorial of this successful forest manager.

Wilbur R. Mattoon, formerly in investigative work in the Forest Service, has been appointed to the States Relations Service work, newly organized in the United States Department of Agriculture, for the Southern States. Austin F. Hawes, formerly State Forester of the States of Connecticut and Vermont, will conduct this work in the Northern and Western States. It is probably that later men will be appointed to carry on woodlot extension work in each of the important woodlot States.

Prof. H. H. Chapman, of the Yale Forest School, who has been spending some time in Albuquerque, New Mexico, the past winter, left about March 15 for Louisiana, where he will assume charge of the annual spring field work for the senior class of the Yale School.

NOTES AND COMMENTS

Injury to Yellow Pine Timber by Steam Logging

Mr. O. F. Ericson reports the results of a recent study of a cutover area on the Crater National Forest, in southern Oregon, to determine the effect of steam logging on the remaining stand of yellow pine timber. A 100 per cent cruise was made on a 16-acre plot containing 243 yellow pine trees, which represented as nearly as possible the condition of uphill yarding on the sale area. The slopes were more or less broken and rocky and were very characteristic of the tract where donkey logging was being carried on. Figures were obtained only for yellow pine, which is the most favored and predominant species in the region, although there are considerable quantities of Douglas fir and white fir to which the damage is usually greater than to the yellow pine. The study showed the number of trees injured, according to the per cent of the trunk girdled, to be as follows:

Per cent	*Number of trees*	*Per cent of total stand*
10	22	9.1
20	4	1.6
30	6	2.5
50 and over	4	1.6
Total	36	14.8

It was noted that the greatest damage was done by the main line and logs rubbing against the trees as the logs are pulled in, which accounts for the large percentage of trees injured to the extent of only 10 per cent and less. The haulback line was usually well guided by blocks, and very little damage was done by this source.. Most of the trees were only injured enough to expose the cambium to a very slight extent. It is believed that these trees will not be retarded in their growth, as the scars are quickly covered over with pitch, thereby preventing the entrance of fungi and insects. The greatest damage to the individual trees was caused by the straps thrown around the tree on which the blocks are placed. This injury, where the straps wear through the bark, usually exposes the cambium layer around the entire tree. However, this can be prevented by instructing the hooktenders to use the inferior species or high stumps for this purpose, thus reducing this

injury to a minimum. Occasionally it is necessary to use yellow pine trees for this purpose, which should always be protected by placing chunks of wood under the straps. The "bull" block, which is always subject to a severe strain, was usually placed on a white fir tree or a high stump. If a tree was used for this purpose, it was felled before the "donkey" moved to the next landing. The smaller blocks used on the main line and haulback line are not subject to a severe strain, and the injury to the trees where these blocks were used was very small.

Changes Proposed in Louisiana Taxation

The recently created Board of State Affairs in Louisiana has attacked the problem of revising the tax lists of the State. The board proposes, first, to make a thorough investigation of the property owned by lumber companies. It is feared by some operators that the timber interests have been singled out and that the agricultural interests are to a considerable extent to be left undisturbed. It is proposed to increase State revenue by raising the value of taxable property on the assessor's books rather than to increase the tax rate. To this end they propose to increase the assessed value of pine timber from $1 per thousand feet to $3 per thousand feet, and also to raise the value of sawmill plants, logging outfits, and other property of lumber companies. The lumbermen of the State are planning a campaign to forestall the proposed increase unless it is applied to all classes of property. A number of interesting facts have been brought to light showing the status of the agricultural interests from the taxation standpoint. It has been estimated that in 1916 the following discrepancy occurred in assessing farm property: Cattle only 49 per cent assessed; horses only 70 per cent assessed; mills only 91 per cent assessed; sheep and goats only 31 per cent assessed; hogs only 6.4 per cent assessed. Fifty-one per cent of the automobiles licensed by the State did not appear on the assessment roll, and also there were 1,500,000 acres of land which escaped taxation. Thirty-five parishes did not assess any farm improvements, machinery or equipment of any kind for farm use, and 25 parishes did not assess a single hog. Lumbermen have felt for a long time that they have borne an undue share of the tax burden of the State, and an effort will be made to put the agricultural interests on a proper basis. An interesting side light on the agricultural tax question has been the antipathy of the farmers toward compulsory

stock dipping laws for the eradication of the cattle tick. In some localities the public dipping vats have, in recent years, been dynamited and destroyed, largely because stock when dipped is counted and the ownership for tax purposes established.

R. C. B.

The Work of the United States Forest Products Laboratory

The U. S. Forest Service Forest Products Laboratory sends out a brief account of the multiform work which it has in hand and some of its findings. We can only recite briefly the direction of work, interesting on account of its variety, and important in extending the more thorough use of wood, thereby increasing its stumpage values.

Strength tests have been made to the number of 137,000. These data were used in two directions, namely, in classifying woods for box manufacture and in formulating definite rules on the variability in the strength of timber and the laws which govern it.

Similar grading rules, based upon density classification, as worked out for southern yellow pine, have also been tentatively elaborated for Douglas fir.

A box-testing machine has developed the fact that increasing the number of nails in the ends increased the strength of the boxes 300 per cent.

Some 3,000 nail-pulling tests seem to have developed the fact that the holding power of nails has a definite relationship to the density of wood, and that there is practically no difference in strength between a solid beam and a beam made of two planks nailed together.

In regard to kiln-drying, several discoveries have been made, *e. g.*, steaming wood proved successful in removing case hardening. The new, high-velocity-low-superheat method of rapid drying has proved satisfactory for southern yellow pine, in securing drying to 6 per cent moisture in 64 hours, and to shipping weight in 39 hours, with less than 1 per cent loss. Red gum has been found possible to kiln-dry satisfactorily; so, too, shoe lasts may be kiln-dried in 21 days, which hitherto took one and a half years to air-dry.

Various materials have been tested for preventing absorption and loss of moisture in wood, the most effective being paraffin; high temperature treatments, and impregnating the wood with sugar were also effective.

As regards rot in buildings, it has been found out that with a temperature approximating 100° F. and a high humidity the mycelia of certain rot fungi can be killed, contrary to existing opinion. For preservative treatment of building material zinc chloride and sodium fluoride are found better than creosote. Rules for restricting the spread of fungi in lumber have been elaborated.

Tests as regards the relative durability of different wood materials are going on. The finding is made that durability of conifer does not depend directly upon the resin content.

Ten different fire-proofing materials have been tested, three of which were found to retard ignition of wood, which, however, after ignition, was completely consumed. Data indicating the relation between combustible contents of a room and the cubic feet of air necessary to destroy them were obtained.

A method of distinguishing longleaf pine from loblolly and shortleaf was based upon the diameter of the pith and the second annual ring. Over a thousand samples of wood were submitted for identification.

As regards wood preservation, sodium fluoride, as a preventive of sap stain, is under promising trial, and also for railroad ties and mine timbers.

An attempt to identify coal-tar and water-gas creosote by physical and chemical means has failed.

Some 66 preservatives were investigated, as regards their toxicity; among these, water-gas tar and coal tar were found fully equal.

The value of chestnut oak for railroad ties is materially decreased by finding that it treats like red oak instead of like white oak.

For preservation of piling, coal-tar creosote and high boiling creosote fractions IV and V have so far shown satisfactory behavior. Creosote containing a metal, such as iron and copper, improves its effect.

Wood-block paving fillers and wood-block floors in factories, etc., have been under investigation. Creosoted wood staves for silos proved that no injurious effect to the appetite or health of cattle was produced.

In the direction of pulp and paper investigation a number of findings have been made. The use of spent hemlock bark for felts gives promise of being immensely important in supplanting 200,000 tons of roofing felts made from rags, the price of rags having, due to the war, risen to $72 per ton, 30 per cent of which can be substituted with

hemlock bark, doubling the value of the latter and saving around $1,000,000 annually. The use of this bark for the manufacture of paper products, increasing at the same time the tannin extraction, gives promise of successful commercial application. A new method of cooking wood by the sulphate process, giving larger yields of greater strength, in shorter time, with less consumption of chemicals than the standard method, has been developed and patented. Loss of chemicals by cooking unbarked chips of yellow pine was investigated, also white and black liquors in the sulphate process were analyzed. An increased yield of 9 per cent in soda pulp, due to introduction of moisture during the cooking period, and the same modification in the kraft process gave excellent results. Darker colored papers, such as are made from tamarack, were found not to produce practically and difference in eye fatigue compared with that from spruce.

As regards utilization of sawmill waste for paper pulp, particularly of hemlock, an extension of its use is foreshadowed.

A chemical analysis of American woods has been begun and completed for a number of species, promising the development of the production of many valuable organic compounds. It was also found that spruce wood contains 61 per cent cellulose, as against a maximum of 45 per cent recovered in the yield of pulp. Attempts to increase the pulp yield are encouraging.

In the manufacture of ethyl alcohol a yield of 20 gallons was obtained per ton of dry wood, all conifers giving excellent yields, but the yields from hardwoods being considerably lower. It is estimated that a properly designed plant of 2,500 or 3,000 gallons, located where sufficient waste is available, can make ethyl alcohol at a cost of 14 to 20 cents per gallon.

A method of purifying turpentine secured in the production of kraft pulp from longleaf pine has been developed.

A field experiment on the width of chipping in the turpentine orchard, with one-fourth-inch streak once a week and with a one-half-inch streak twice a week, averaged about 20 per cent less from the narrower chipping than from the standard, but double chipping produced about 20 per cent greater yield than the standard, indicating the possibility of greatly increasing the yield of turpentine and rosin. The new annual growth rings, formed after the trees were chipped, show that the cell formation began earlier and produced more normal

wood than in the heavy chipping, at the same time avoiding the tendency to "dry face."

Osage orange has been demonstrated a good dye wood, now $750,000 worth being used.

With a view to discovering possible new uses for wood distillation products as a provision against the slump in this industry which seems pending upon the cessation of the present war, experiments were started to produce solvents from crude acetone oils. These studies have succeeded in producing on a laboratory scale some water-white solvents which have given excellent results in dissolving twelve of the most important gums used in the lacquer and varnish industry.

The University of Washington College of Forestry announces favorable progress in negotiations for the proposed demonstration forest. In August, 1915, the representatives of the United States Forest Service approved selection by the State of the Pilchuck and Sultan watersheds, in Snohomish County, Washington, in lieu of a portion of the State school lands scattered throughout the National Forests. During the recent session of the Washington Legislature an act was passed authorizing the university to exchange a portion of its more or less scattered land grant for the above tract. Since the necessary surveys will require a year, the transfer is expected to be completed in about that time.

The tract in question contains about 60,000 acres, about 40,000 of which is commercial timber land, the rest being above the commercial timber zone. The stand is estimated at approximately 1,700,000,000 feet b. m., and includes all coniferous species of western Washington, though western hemlock, Douglas fir, and western red cedar predominate, in the order named. It is accessible along one side, so cutting can begin almost immediately. As a matter of course, cutting will be regulated on the principle of approximate sustained annual yield. The presence of considerable areas of younger age classes contributes to easy introduction of this kind of management. The possible annual cut, estimated to be in excess of 30,000,000 feet, will be of such size as to make an efficient logging operation possible, even under steam logging conditions. The logging will not, however, be carried on by the university, since it is deemed best to sell stumpage instead, at least for the present. In stumpage sales, privileges aimed at giving students practical experience and insight into the operations will be reserved.

In addition to the business feature of the management, the tract will be used for extended experimental work in silviculture. The variety of age classes and species makes it specially adapted to this purpose.

Mr. Cox, State Forester of Minnesota, foreshadows the more general use of aviators for forest-fire patrol after the experience with such a patrol in Wisconsin, and compares the cost with regular foot patrol. In the latter, to every 1,000,000 acres twenty-two patrolmen would be needed, or 110 for a unit of 5,000,000 acres, who would cost around $60,000 for the six months' fire season, which, if it is assumed that $100,000,000 of value is to be found on the area, brings the cost to .06 per cent.

A hydroplane, which is the kind to use in the lake-studded northern forest, lasting three years, costs $7,750 per annum; repairs, $600; two aviators, at $200 per month, and two observers, at $100, besides a mechanic, at $80, brings the crew charge for five months to $4,080, and the total for 5,000,000 acres to $12,430, or about one-fifth of the foot patrol. Considering, however, that the latter cannot be entirely dispensed with, allowing twenty-five foot patrols, the net saving in aerial patrol figures $25,880, *i. e.,* cutting the cost in half or better.—*American Forestry,* February, 1917, p. 107.

B. W. Lakin, superintendent of the Crookston Lumber Company, at Bemidji, Minnesota, reports that the company for the past ten years has pursued the policy of burning their slash on over 10,000 acres a year; this in stands of mixed conifers, with an average of 8,000 feet to the acre, cut to a 6-inch log. The brush is piled while logging (with a Lidgerwood cableway) and burned in the early spring before the fire can run (before May 1), under careful supervision. This is done with a kerosene torch made of 1½-inch gas pipe, capped at one end, and a reducer from 1½ to ½-inch on the other end, and a piece of ½-inch pipe, 10 inches long, filled with wicking. The torch will last with one oil filling for two to three hours. The cost need not be over 50 cents, and averages between 10 and 20 cents per *acre,* or, say, 2 cents per *M feet.*—*Canadian Forestry Journal,* March, 1917, p. 1003.

The last session of the Idaho State Legislature passed a workmen's compensation act, to some extent similar to the act now in force in

Montana. The schedule of compensation is taken from the Montana law.

There are two plans of insurance incorporated in the act. One provides for a State insurance department, to be headed by a commission of three men, and in addition a manager. The other plan permits employers to carry their own insurance after they have posted with the State a surety bond to cover the payroll, if such a sum is demanded to guarantee the payment of claims.

Liberal provision is made for medical attendance, and also for the safety of workmen. Employers may maintain their own hospital fund, to which employes must contribute $1 per month. The law goes into effect July 1, 1917.

The California Legislature has gone on record as favoring the enactment of laws by Congress to permit the cutting of ripe timber in the National Forests of California, and the use of the money thus realized for the purpose of financing flood-control projects.

There are supposed to be 106,000,000,000 feet of ripe merchantable timber in the various National Forests in California, and it is estimated that the revenue from this would be more than $200,000,000. More than 50 per cent of this timber is close to good transportation facilities, and instead of being an unnecessary loss it could be made into lumber and put to beneficial use under the plan proposed.

The storage reservoirs for impounding the flood waters in the State could be constructed for $100,000,000.

Under the proposed plan, the State would manage the funds, and they would be used for flood control and reclamation purposes.

A process to utilize mill waste by distilling has been developed to commercial issue by Dr. J. G. Davidson, of the University of British Columbia. By means of this process tar, a light oil, acetate of lime and charcoal are formed. The gas produced by distillation is carried through a pipe 9 inches in diameter and 20 feet long. In this pipe is an electrically charged wire, which causes precipitation of the heavy particles of tar. The tar, 40 gallons for each cord of wood distilled, is of medium consistency and immediately marketable. The light oil, obtained in a water condenser, is immediately marketable for use in ore refining, and the yield is 12 gallons to the cord of wood. Eighty pounds of acetate of lime are obtained from the pyroligneous acid of

each cord of wood. Nine hundred pounds of charcoal are the final yield.—*Canadian Forestry Journal,* March, 1917, p. 1027.

In these war times the work of Indian entomologists in Persia in the control of flies and vermin is of interest to American foresters. The problem divides itself into (1) disposal of fly-breeding material, (2) fly poisoning, and (3) fly spraying in trenches and hospitals. A copy of the instructions, issued to troops, is given in full in the *Indian Forester* for January, 1917.

The Public Domain Commission of Michigan has asked the State Legislature to increase the annual appropriation to $150,000. The commission is preparing to carry into effect the most gigantic forest conservation and tree-planting plan which any State has yet attempted in the United States. The plan is approved by forestry experts at the University of Michigan and the Michigan Forestry Association. It is proposed to plant trees at the rate of 4,500 acres per annum, and in what is known as the rotation period of sixty years. A total of some 270,000 acres are to be planted, as called for in the plan.

Judge Wilbur F. Booth, in the United States district court in Minneapolis, Minn., on March 15 last, handed down a decision in the Government suit against the Northwestern Lumbermen's Association, a retail lumber dealers' association, representing about 2,700 yards in the States of Minnesota, Iowa, and the Dakotas. The chief effort of the Government in the suit was directed against the use of "customers' lists," by means of which it was charged that information was disseminated to members regarding sales by wholesale merchants and by manufacturers direct to consumers, including mail-order houses and cooperation yards. The decree, as handed down, forbids further activities of this character on the part of the association. The present civil suit was begun in 1913, after criminal proceedings started in 1911 had been dropped. The final arguments in the case were made during the latter part of 1914, and the decision has only now been handed down. This suit was one of several started some years ago to break up the alleged "lumber trust." It has been regarded as of much importance, and the exceedingly voluminous records were reported in the lumber trade journals as the suit progressed. The association states that the activities now forbidden were discontinued before the suit was

instituted, and hence the decision will not alter association activities. Nevertheless, the case will be carried to the United States Supreme Court for final decision.

The fire prize offered by the District Forester of the Southwestern District was awarded for the 1916 season to the Coconino National Forest for making the best fire record. In a very unusual year for the Southwest this Forest had a total of 194 fires, divided as follows: Class A, 141; Class B, 49; Class C, 4. The total acreage burned over was 385.4, the total damage $440.32, the total cost of extinguishing $522.74. The average acreage burned over per fire was 1.98, the average damage per fire $2.27, the average cost per fire $2.69. The first fire occurred on March 18 and the last one on November 25. The largest fire covered 158 acres. The prize consists of a framed letter of commendation to the local forest officers whose names are given in the letter.

Recent estimates place the annual income from the forests of Finland at $96,500,000. Exports of forest products now constitute 70 per cent of the total exports of the country. A Finnish timber trade committee recently proposed that the following measures be taken to increase the yield of the forests: The selection of trees suitable to the district in which they are to be grown and the increasing of the proportion of broadleaf trees in south Finland at least, the introduction of selective felling, and improvement in the drainage of the forests.

The Spanish Government, at the instigation of the king, has recently enacted a law providing for the creation of national parks. All exceptionally picturesque regions, forests, or lands that the state may select for the purpose are to be considered part of the park system. The natural beauty of the parks, their fauna and flora, as well as geological or water features of interest, will be protected from destruction, deterioration, or defacement.

It is understood that the Forest Service has decided that a small flag will be used hereafter for identifying automobiles and motorcycles which are used on official business by forest officers. The flag is to be displayed on all machines operated under official mileage authorizations or officially owned while on official trips. The emblem adopted is

similar to that used unofficially for several years in the Service, and consists of a dark-blue pennant, about 10 by 14½ inches in size, on the middle of which is set a tree in a shield, surrounded by thirteen stars. The shields and stars are in white.

Forest Service reports give the information that approximately 7,000 head of cattle on the National Forests were lost during 1916 from eating poisonous plants. Of this number at least 90 per cent were poisoned from eating tall larkspur; this 90 per cent were valued at $300,000. The principal losses occurred in the higher ranges of the States lying between Washington and New Mexico.

It is understood that the forest supervisors of District One, at their meeting in Missoula, Montana, in February, sent a wire to Washington expressing their support and readiness to accept any service they might be called upon to give their country in case of war. The Forest Service is completing a detailed census of its officers, classifying them according to special fitness or training, to be used in case of actual hostilities.

The 1917 fire season in the Southwestern District has already opened up, a considerable number of fires having been reported from the Alamo Forest, in New Mexico, and several on other forests in that district. The 1916 season in the Southwest was said to have been the worst since 1908.

The National Forest Reservation Commission, organized under the Weeks law for the protection of navigable streams, spent $1,458,649.24 during 1916 for the purchase of areas already examined and approved for purchase. Sixty-five tracts, aggregating 54,898 acres, were approved by the commission for purchase, at an average price of $5.76 per acre during 1916.

Prairie dogs have been practically destroyed on 767,000 acres of National Forest range in New Mexico and Arizona during the past five years by the United States Biological Survey. During that period a total of about 2,500,000 acres of Government land in the West have been relieved of range-destroying rodents.

The Southern Pacific Railroad Company is planning to erect on the shores of Roosevelt Lake, on the Tonto Forest, a large tourist

hotel. The area to be used is covered by a Forest Service permit, being a long-term lease.

The National Lumber Manufacturers' Association reports a marked revival in the construction of wooden sea-going schooners for use as freighters. Many orders are reported by shipyards in both Canada and the United States. The submarine campaign and the high price of steel have combined to bring this revival about.

The Secretary of the United States Department of Agriculture has proposed the establishment of a Board of Forest Affairs, to represent and correlate the work of the Forest Service, the Federal Trade Commission, and the Bureau of Domestic and Foreign Commerce. The plan, it is understood, also provides for an advisory council of lumbermen to collaborate with the proposed board.

It is reported that the Southwestern District is planning to build up a mailing list of ministers of the gospel in or near National Forests for the purpose of supplying them each spring with special fire publicity material.

The 1918 Agricultural Appropriation Bill, which was signed on March 4 by the President, provided increases in salaries of 5 per cent for persons in the United States Department of Agriculture receiving from $1,200 to $1,800 per annum, inclusive, with a 10 per cent increase for those receiving a salary less than $1,200. This measure was justified on account of the greatly increased cost of living expenses.

The Arizona Cattle Growers' Association at its annual meeting held at Globe, Arizona, on March 1 to 5, passed strong resolutions recommending the turning over to the State all the public domain as well as all the National Forests. This action is thought to be a "comeback" on the recent increase made by the Forest Service in all grazing fees in opposition to which the stockmen of Arizona took a very prominent part.

Beech nuts have proved of considerable value in Germany for the manufacture of oil and margarine. In view of the scarcity of fats in that country, the heavy crop of beech nuts last fall in southern and

western Germany and on the western battle front was particularly opportune in adding to the supply.

Wood waste and sulphite lye are being used in Germany for the manufacture of ethyl alcohol. A cubic foot of wood is said to yield about a quart and a half of alcohol.

A bulletin of Kew Gardens advises the growing of *Rhamnus frangula* in coppice as specially profitable for the manufacture of charcoal fit for fireworks. Before the war the scarcity of this material had raised the price to $50 and $70 per ton. A sandy clay of medium quality is suitable. The plants grown in nursery are set out in rows 1 foot apart, 6 inches in the row, and when 9 to 10 inches high are coppiced.

The use of the motor car in connection with fire fighting, according to District Forester G. P. Melrose, of the British Columbia Forest Branch, saved in his work for the fire season of 1916 around $950; this amount being figured out by comparing what each trip with the motor would have cost in time and money if carried out using existing means of travel, namely, forty-five days of the District Forester, twelve days of a ranger, and fourteen days of a ranger on a motorcycle. Besides, the greater efficiency, due to saving time, must be taken into consideration.—*Canadian Forestry Journal*, March, 1917, p. 995.

The University of California Forestry Club proposes to publish a monthly magazine of its own under the title *California Forestry*. Its object is mainly to "get acquainted," but articles of technical import, and, indeed, "on all phases of forestry," are also intended to be published. The subscription price is to be $1, and of the 700 subscriptions necessary to keep the magazine running it appears that 500 have already been guaranteed.

District 5 estimates that during 1916 over 700,000 people used the California National Forests for recreational purposes.

CONTENTS

Vol. XV MAY, 1917 No. 5

JOURNAL OF FORESTRY

OFFICIAL ORGAN OF THE SOCIETY
OF AMERICAN FORESTERS

COMBINING THE PROCEEDINGS OF THE SOCIETY AND THE FORESTRY QUARTERLY

PUBLISHED BY THE
SOCIETY OF AMERICAN FORESTERS
At 930 F STREET N. W.
Washington, D. C.

Single Copies, 50 Cents Annual Subscription, $3.00

Entered as second-class matter at the postoffice at Washington, D. C., under the act of March 3, 1879

JOURNAL OF FORESTRY

A professional journal devoted to all branches of forestry

EDITED BY THE EDITORIAL BOARD OF
THE SOCIETY OF AMERICAN FORESTERS

The Journal appears eight times a year—monthly with the exception of June, July, August and September.

The pages of the Journal are open to members and non-members of the Society.

Manuscripts intended for publication should be sent to Prof. B E. Fernow, at the University of Toronto, Toronto, Canada, or to any member of the Editorial Board.

Subscriptions and other business matters may be addressed to the Journal of Forestry, Atlantic Building, 930 F Street N. W., Washington, D. C.

JOURNAL OF FORESTRY

VOL. XV MAY, 1917 No. 5

TREE GROWTH AND CLIMATE IN THE UNITED STATES

By K. W. WOODWARD

Professor of Forestry, Durham, N. H.

The purpose of this paper is to summarize the available information with regard to forest yields in the United States and attempt to determine the relation of these yields to climate and soil. In the discussion which is to follow the following forest types will be recognized: 1, spruce type; 2, northern hardwood type; 3, white pine type; 4, southern hardwood cove type; 5, southern hardwood slope type; 6, southern hardwood ridge type; 7, southern pine type; 8, southern bottom land type; 9, western yellow pine type; 10, lodgepole pine type; 11, Engelmann spruce type; 12, silver pine type; 13, sugar pine type; 14, sequoia type; 15, Douglas fir type. In differentiating these types an attempt has been made to segregate the areas of tree growth which have similar climatic and soil characteristics and tend toward an ultimate stand of the same composition.

Spruce type

The spruce type which is found in New England, Michigan, Wisconsin, Minnesota, and New York, and in scattered islands southward in the southern Appalachians to North Carolina, is characterized by a relatively short growing season, not more than four months, a total annual precipitation of at least 35 inches, medium run-off on account of the long winter season, and slow evaporation by reason of the low temperatures. As a consequence there is a relatively large amount of available moisture present for tree growth. This is true in spite of the fact that the cold winters necessitate foliage which is adapted to the dry conditions prevailing under low temperatures.

The characteristic species of this type are red spruce, balsam fir, tamarack, and paper birch. Using a rotation of 100 years as a standard, spruce will attain a diameter, breast high, of 10 inches, and a

total height of 70 feet in that time, while balsam will attain a diameter of 11 inches and a total height of 83 feet. Density figures are only available for spruce. In 100 years, the number of trees per acre is reduced on Quality I sites to 415 from over 2,000 trees at 20 years of age. Yield data exist for both red spruce and paper birch. The former will yield on good sites 7,400 cubic feet in 100 years, while paper birch will give 5,500 cubic feet with an understory of spruce ready to take its place when the intolerant paper birch is cut out.

Northern Hardwood Type

The northern hardwood type in which the characteristic species are red spruce, beech, yellow birch, and sugar maple has a slightly longer growing season than the spruce type. This is natural because it is located just below the spruce type in altitude. The total annual precipitation averages slightly less. Forty inches is a good figure for the type throughout its range, although it ranges from 30 inches in the Lake States to 45 inches in Maine and New Hampshire. The run-off will be approximately the same as in the spruce type because the higher temperatures and longer growing season are offset by the less acute slopes. Likewise there is little difference in the evaporation of the two types, although there would naturally be slightly more from the hardwood type on account of the longer growing season. The total amount of available moisture is unquestionably less than in the spruce type on account of the lower total annual precipitation and the slightly greater evaporation. However, the vigor with which spruce grows in this type indicates that there is comparatively little difference between climatic conditions. What advantages there are, are in favor of the hardwood type with its longer growing season which permits greater diameter and height development.

On account of the lack of pure stands yield figures for the hardwood type are neither abundant nor satisfactory. As yet we have done comparatively little to determine yields of our mixed stands. Mr. Hawes has, however, worked up some yield figures for Vermont hardwoods from which it is estimated that they will yield in 100 years 7,000 cubic feet. The Forest Service figures on aspen also permit of an estimate of the possible returns from this species in the same length of time. Thirteen thousand cubic feet seems to be a conservative figure for aspen in spite of the fact that it is an intolerant species and the density is low. It is improbable that there will be more than

60 aspen trees per acre in a rotation of 100 years on Quality I sites. The density for northern hardwoods is estimated to be 275 trees per acre at 100 years. In spite of the slightly longer growing season aspen seems to be the one species which makes much more rapid diameter and height growth than is attained in the spruce type. Its diameter and height in 100 years are estimated to be 23 inches and 89 feet, respectively. Sugar maple in the same length of time will attain 12 inches and 75 feet, yellow birch 12 inches and 74 feet, and the average for the Vermont hardwoods is estimated to be 10 inches and 85 feet.

White Pine Type

The white pine type includes the sandy soils which are too dry for the growth of northern hardwoods and occurs in New England, New York, and the Lake States. White pine is the dominant species, although beech, birch, maple, red oak, and ash are often found occurring in association with white pine. On the drier sites, especially in the Lake States, red pine and jack pine are also found in this type. Climatically it is characterized by a growing season from four to six months in length; total annual precipitation 30 to 45 inches, medium run-off and evaporation. In spite of the rapid drainage of the sandy soils the gentle slopes tend to counterbalance the openness of the soil. Summing up, there is unquestionably less available moisture for tree growth in this type than in the hardwood type, but unfortunately our records do not permit us to measure this absolutely; a growing season of fair length permits of rapid diameter and height growth.

White pine attains in 100 years on Quality I sites an average diameter of 20 inches and total height of 113 feet, while red pine in the same length of time will reach 24 inches and a total height of 101 feet. Yield tables for white pine show that the best sites have a density of 154 trees per acre in 100 years and will yield 14,700 cubic feet without thinning.

Southern Hardwood Types (Cove-Slope-Ridge)

Climatically the southern hardwood types come next because their characteristics are very similar to the southern extension of the white pine type. However, the total annual precipitation is greater, the run-off more rapid on account of the open winter, and the evaporation considerably greater by reason of the longer growing season which covers from five to seven months. Unfortunately it is not possible

with our present information to define the climatic and soil conditions in the various southern hardwood types with exactness. Nevertheless, it is perfectly clear from even a superficial examination that the hardwood coves possess more available soil moisture than either the slopes or the ridges. This is almost entirely due to drainage conditions and soil composition. The coves, being at the bottom of the slopes, are naturally better watered and the soil is deeper. At the other extreme the ridges are over-drained and their soils are shallow. The slope type occupies an intermediate position between the two. In accordance with these differences in run-off, the virgin stands in the coves average 15,000 board feet to the acre, while the ridges seldom exceed 2,000 board feet and the slopes occupy an immediate position with an average stand of about 8,000 board feet.

Unfortunately growth figures for the three types are not available for the reason that data have not been collected for them separately; the growth figures have been secured by species without any attention being paid to the conditions under which these species are growing. However, it seems safe to say that the cove type cannot be expected to yield more than 10,000 cubic feet per acre in 100 years. Under the same conditions, the slope type will give approximately 5,000 cubic feet and the ridge not more than 1,000 cubic feet. Satisfactory density figures are almost wholly lacking, but it is estimated that yellow poplar coves will not contain more than 125 trees in a rotation of 100 years. Outside of the cove type there are no diameter and height figures which can be relied upon. In this type yellow poplar will attain a diameter of 25 inches and a total height of 125 feet, chestnut 20 inches and 93 feet, respectively, and hemlock 21 inches and 98 feet.

Southern Pine Type

The southern pine type in which longleaf pine is the dominant species is characterized by a growing season of nine to eleven months. The total annual precipitation of approximately 55 inches. Rapid run-off and rapid evaporation are the rule. The run-off is rapid not on account of the slope but by reason of the open sandy soil upon which the type grows. The reason for rapid evaporation is the long growing season. On the southern limit of the type, the climate is sub-tropical in character so that the evaporation will aproach that of the tropics, where 64 inches are annually evaporated from water surfaces.

Under favorable growth conditions loblolly pine, the fastest growing species in this type, will attain a diameter of 24 inches and total height of 111 feet in 100 years. The density in this type is low because the species are relatively intolerant and there is a small amount of available soil moisture. The best estimates show an average density of not more than 75 trees per acre with total yields of approximately 7,000 cubic feet per acre.

Southern Bottom Land Type

In spite of the long growing season, from nine to eleven months, and the rapid evaporation which this long growing season entails, there is a relatively large amount of available soil moisture on account of the slow run-off. This in turn is due to the fact that the drainage is poor. This type includes the swamp and bottom lands of the southern coastal plain, of which the Dismal Swamp and the Everglades are the most striking examples. The most characteristic species are cypress, tupelo gum, red gum, with some loblolly pine, cottonwood, and ash in association. Diameter, height growth, and yield are all high in this type on the better drained sites; for example, cottonwood, which never occurs except on the relatively high portions of the swamps immediately adjacent to the river banks, reaches an estimated diameter of 37 inches and a total height of 150 feet in 100 years. Cypress will attain 33 inches in diameter and 119 feet in the same time, while ash will reach 31 inches and 117 feet, and red gum 27 inches and 90 feet.

No satisfactory density figures are in existence and the only yield data are for cottonwood, which shows a total yield of 12,000 cubic feet in 100 years on Quality I sites. Of course these growth and yield figures only apply to the better drained sites. In the wet back swamps where there is more or less water standing all the time, the growth is not nearly so rapid. Too much moisture is of course just as bad as too little, and has approximately the same effect in retarding the growth.

Western Yellow Pine

In this type western yellow pine is the dominant species, although occasionally Douglas fir, lodgepole pine, and alpine fir do occur. The type is characterized by all qualities of soil, although clay loam is the most common. The growing season is from five to seven months in length; the precipitation never exceeds 30 inches and may drop off to 20 inches per annum; the evaporation is rapid on account of the

dry climate, and the run-off is greatest in the southwest on account of the longer growing season and the torrential character of the rains. No satisfactory growth figures exist for this type, so that it is only possible to say in a general way that the individual trees grow relatively slowly, all mature stands are very open, and the yield in 100 years will not average better than 1,500 cubic feet.

Lodgepole Pine Type

This type grows immediately above the western yellow pine type and is characterized by a shorter growing season, slightly heavier precipitation, more rapid run-off on account of the steeper slopes, but less rapid evaporation. Hence there is a slightly larger amount of available moisture. In 100 years lodgepole pine will attain under favorable conditions a diameter of 12 inches and total height of 70 feet. No figures exist for its associated species, Douglas fir and alpine fir. The yield can only be estimated, but it seems safe to say that it will not exceed 5,000 cubic feet in 100 years.

Engelmann Spruce

This type is confined to the summits of the Rocky Mountains. As a consequence it is characterized by a short growing season, not more than 35 inches of precipitation, medium run-off and evaporation, and shallow soils. The amount of available moisture is greater than in the lodgepole pine type because of the heavier precipitation and less rapid run-off and evaporation due to the long winters. Satisfactory growth and yield figures are not available for this type, so that it can only be stated in a general way that the individual trees do not reach such large size as in the lodgepole pine type, but the number of trees per acre is greater so that the yield will probably be larger than in the lodgepole pine type. It is estimated to be 6,000 cubic feet.

Silver Pine Type

In northern Idaho the climatic conditions are such that the silver pine and red cedar grow abundantly. Both these species will attain, under favorable site conditions, a larger size in 100 years than is possible in the other Rocky Mountain types. Likewise the density and yield per acre are heavier; as a consequence it is estimated that this type will yield approximately 10,000 cubic feet in 100 years. The characteristic species are silver pine and red cedar, although Douglas fir, western larch, and alpine fir are also found in association with the

dominant species. The climatic factors which make more rapid growth and higher yields possible in this type are heavier precipitation, less rapid run-off, and evaporation. The mountain ranges in the northern part of Idaho upon which this type occurs are in the direct path of the moisture laden winds from the Pacific Ocean and the cooling which occurs as the winds rise in crossing the mountain ranges results in an area of relatively high precipitation in northern Idaho and northwestern Montana in spite of the fact that eastern Washington and Oregon are desert-like in character. The total annual precipitation, for example, at Murray, Idaho, is 40 inches. The short growing season retards run-off and evaporation.

Sugar Pine Type

The dominant species are sugar pine, incense cedar, and yellow pine. Sugar pine under virgin conditions attains a diameter of 24 inches and a total height of 111 feet in 100 years, while yellow pine and incense cedar reach 20 inches and 94 feet, and 14 inches and 65 feet, respectively, in the same length of time. The average yield will not exceed 2,000 cubic feet per acre in a 100-year rotation. The growing season is relatively long, from five to seven months, the precipitation medium, about 35 inches, and the run-off and evaporation medium to large. Consequently the available moisture is not great. This is evidenced by the relatively open stands.

Sequoia Type

While there are groves of sequoias in the Sierra range, the largest areas of trees of this genus occur in the California coast ranges immediately east of the Pacific Ocean. These are the famous redwoods of northwestern California and southwestern Oregon. The climate of the redwood region is characterized by a long growing season, seven months, total annual precipitation ranging from 25 to 50 inches, and relatively rapid run-off and evaporation. As a consequence the total amount of available moisture is approximately the same as in the sugar pine type, but the longer growing season permits of greater individual development. As a consequence the trees attain the largest size of any on the American continent. It is estimated that in 100 years a redwood will reach a diameter of 35 inches and a total height of 150 feet. No yield figures are available, but it seems reasonable to assume that a yield of 10,000 cubic feet per acre is possible in 100 years.

The climatic conditions under which the big trees of the Sierra

range (*Sequoia washingtoniana*) grow do not differ materially from those characterizing the redwood belt. Moreover the groves of big trees in the Sierras are so small relatively that they are of little importance in this discussion. Consequently, they have not been considered separately.

Douglas Fir Type

This type possesses the heaviest precipitation of any forest type in the United States with the possible exception of small areas of sub-tropical growth in southern Florida. The average annual precipitation is 80 inches and the run-off and evaporation are only medium. Furthermore the growing season is relatively long, approximately six months in length. As a consequence not only does Douglas fir attain a diameter of 24 inches and a total height of 154 feet, but the number of trees per acre is relatively large, 115 in 100 years. The yield of 15,600 cubic feet in 100 years is the greatest for the United States. Douglas fir is the dominant species in this type, but hemlock, red cedar, and western larch are also found in small quantities.

SUMMARY

In order to bring out the relation between tree growth and climate, it is necessary to arrange the various types discussed with reference to the different factors. Taking the length of growing season first, the following list shows the various types in descending order of length of growing season: 1, southern pine type; 2, southern bottom land type; 3, sequoia type; 4, southern hardwood types; 5, sugar pine type; 6, Douglas fir type; 7, western yellow pine type; 8, white pine type; 9, silver pine type; 10, lodgepole pine type; 11, northern hardwood type; 12, Engelmann spruce type; 13, spruce type.

Arranged in order of total annual precipitation, the types may be listed as follows: 1, Douglas fir type; 2, southern hardwood types; 3, southern pine type; 4, southern bottom land type; 5, spruce type; 6, sequoia type; 7, northern hardwood type; 8, white pine type; 9, Engelmann spruce type; 10, silver pine type; 11, sugar pine type; 12, lodgepole pine type; 13, western yellow pine type.

With reference to run-off, the classification is more difficult. The following list is merely given as a tentative one proceeding from the types that have the least run-off to those that have the most. Length of growing season and steepness of slope were both taken into consideration: 1, spruce type; 2, northern hardwood type; 3, southern

bottom land type; 4, white pine type; 5, Engelmann spruce type; 6, silver pine type; 7, lodgepole pine type; 8, sugar pine type; 9, western yellow pine type; 10, sequoia type; 11, Douglas fir type; 12, southern pine type; 13, southern hardwood types.

Likewise it is impossible to give absolute figures for evaporation so that the following list is merely a crude classification proceeding from the types which have least evaporation to those that have the most. The length of the growing season and general dryness of the climate are the important factors here: 1, spruce type; 2, northern hardwood type; 3, Engelmann spruce type; 4, white pine type; 5, lodgepole pine type; 6, Douglas fir type; 7, southern hardwood cove type; 8, sequoia type; 9, southern hardwood slope type; 10, sugar pine type; 11, western yellow pine type; 12, southern bottom lands type; 13, southern pine type; 14, southern hardwood ridge type.

The standings with reference to total precipitation, evaporation, and run-off are mainly useful as far as they give some measure of the amount of available moisture. Since there are no absolute figures for evaporation and run-off and only meager data on precipitation the rating according to available moisture must be rough since it is based uopn relative data only. Arranged in order of the probable amount of available moisture the types are as follows: 1, Douglas fir type; 2, spruce type; 3, northern hardwood type; 4, southern bottom land type; 5, Engelmann spruce type; 6, white pine type; 7, silver pine type; 8, southern hardwood cove type; 9, sequoia type; 10, southern hardwood slope type; 11, southern pine type; 12, lodgepole pine type; 13, sugar pine type; 14, western yellow pine type; 15, southern hardwood ridge type.

In spite of the meagerness of the data now extant it seems feasible to draw some tentative conclusions in regard to climatic conditions and their relation to diameter and height growth, density, and yield. Stated briefly, these are:

Rapid diameter and height growth require a long growing season and a fair amount of available moisture. For example, the types which have the largest individual specimens answer these requirements as illustrated by the sequoia type, Douglas fir type, and the southern hardwood coves.

Density is dependent upon the amount of available moisture and varies directly with it. For example, the only types in which dense stands occur, Douglas fir, northern spruce, Engelmann spruce type, southern bottom land, and white pine type, all have a relatively large

amount of available moisture due to heavy precipitation or retarded run-off or evaporation.

Yield is the result of the three factors of diameter growth, height growth, and density, but density seems to be the most important of the three, since the stands that yield the highest are the ones with the greatest density per acre.

Climatic and soil factors will not entirely account for the differences on yield. Specific differences also enter into the problem. Some species seem so well adapted to their environment that they grow rapidly and densely in spite of untoward conditions. For example, the eastern white pine seems peculiarly fitted for its rôle in rate of growth, tolerance, and reproductive capacity. Were all types of the same composition, the exact effect of the climatic and soil factors would come out more clearly, but each has its own tree species which thrive best under the peculiar and complex conditions which differentiate it from other types.

Using the data given above as a basis, it is possible to determine the relative values for forest production of the land in the types which have been discussed. In making this calculation it will, of course, be necessary to make the conditions uniform. Therefore, it is assumed that the rotation is 100 years, the rate of interest 3 per cent, no returns are expected from thinnings, but no allowance is made for losses from fire, insects, and fungi. The stumpage value at the end of the rotation is estimated to be $10 per M, $10 per acre is allowed for regeneration, and 50 cents per acre for annual expenses. The following yields per acre for the different types have been used. The value per acre for forest production purposes is also given. Arranged in descending order, they are:

Type	*Yield Per Acre* *Cubic Feet*	*Board Feet*	*Productive Value*
Douglas fir	15,600	90,000	$22
White pine	14,700	84,000	19
Southern bottom land	12,000	72,000	12
Hardwood cove	10,000	60,000	6
Silver pine	10,000	60,000	6
Sequoia	10,000	60,000	6
Northern spruce	7,400	44,000	−3
Northern hardwoods	7,000	44,000	
Southern pine	7,000	42,000	
Engelmann spruce	6,000	36,000	
Hardwood slope	5,000	30,000	
Lodgepole pine	5,000	30,000	
Sugar pine	2,000	12,000	
Western yellow pine	1,500	9,000	
Hardwood ridge	1,000	6,000	

It is evident from this table that the most valuable types for forest production purposes are Douglas fir, white pine, and the southern bottom lands. These three stand in a class by themselves. The next group, which includes the southern hardwood coves, silver pine, and sequoia types, are at least 15 per cent less productive. Northern spruce, northern hardwoods, southern pine, and Engelmann spruce come next, with yields 40 per cent less in volume per acre than the leaders.

The remaining types are so low in productive value that it is seldom that forestry can be practiced on them for timber production alone. Of course, where there are protective or esthetic values concerned the forest fully justifies itself.

LAWS OF TALL-TREE GROWTH INVESTIGATED MATHEMATICALLY

By Prof. R. D. Bohannan

Ohio State University

It is assumed in what follows that the trees are growing in suitable localities, under forest conditions, with mutual protection from the wind and sufficient crowding to destroy lateral buds, leaving the full energy of the tree to the terminal bud, so that the tree, in its contest for light with its neighbors, takes the form of a tall cone tapering under a small constant angle to a small top.

(A) Neglecting the influence of the top on the stability of the tree and assuming still air, the greatest height the tree can reach, without bending under its own weight, if slightly tilted out of the vertical, is given by the formulas:

$$\frac{H}{\sqrt[3]{r^2}}=1.97\sqrt[3]{\frac{E}{w}}\text{, for cones.}$$

$$\frac{H}{\sqrt[3]{r^2}}=1.25\sqrt[3]{\frac{E}{w}}\text{, for cylinders (palms).}$$

And if we assume the bole of the tree has the form of a paraboloid of revolution (a supposition justified by experiments), the corresponding formula is:

$$\frac{H}{\sqrt[3]{r^2}}=1.71\sqrt[3]{\frac{E}{w}}$$

It thus appears that of these three forms the cone-form allows the greatest possible still-air height, and for this reason we have selected this form for the determination of H. Selection of the paraboloid-form would diminish our value of H by about 10 per cent and thus increase the value of k in the equations of the form, $h=kH$, by about 15 per cent, but would not otherwise affect the conclusions.

In these formulas r is the stump-radius *in inches;* E is the modulus of elasticity in pounds per square inch for green wood of the species being considered, w is the corresponding weight per cubic foot of the same green wood, and H the height *in feet.*

These formulas will be proved at the end of this paper. The value of H given by the cone formula for any value of r will be referred to in what follows *as the greatest possible still air-height of the tree for that value of r*, and will be denoted by H.

(B) Throughout long periods of the steady growth of trees the following laws of growth hold:

(1) The height divided by the cube root of the square of the stump-radius remains nearly constant, this constant being different for different species and dependent upon the energy of the terminal bud.

(2) The height, throughout the same period, on any stump-radius, maintains a nearly constant ratio to the greatest still-air height possible on the same radius.

(3) The ratios mentioned in (1) and (2) generally increase rapidly in youth until they reach their normal value (exceptions in opposite directions are redwoods and Douglas firs; see special tables following). These ratios diminish in old age. They are also affected by local environment, so that the tallest tree of any species need not be also the tree of maximum diameter.

If h denote the actual height of the tree on the stump-radius r, laws (1), (2) are equivalent to:

$$h = c\sqrt[3]{r^2} \qquad (a)$$

$$\frac{h'}{h''} = \sqrt[3]{\frac{r'}{r''}} \qquad (b)$$

$$\left(\frac{h'}{h''}\right)^3 = \left(\frac{r'}{r''}\right)^2 \qquad (c)$$

$$h = kH \qquad (d)$$

$$\frac{h'}{h''} = \frac{H'}{H''} \qquad (e)$$

Here h' is the height on the stump-radius r'; h'' the height on the stump-radius r''; H', H' the greatest possible still-air heights on r', r''. Equation (c) will, of course, show greater divergence than (b), since a given divergence in a cube root will show up threefold in the cube.

(C) Since by (B) $h = cr^{\frac{2}{3}}$

$$\therefore \quad \frac{dh}{dt} \div 2\frac{dr}{dt} = \frac{c}{3}\,\frac{1}{\sqrt[3]{r}} = \frac{\sqrt[3]{c^2}}{3}\,\frac{1}{\sqrt{h}}$$

That is, the time-rate of height growth divided by the corresponding time-rate of stump-diameter growth, during long periods of the steady growth of the tree, varies inversely as the cube root of the stump-radius, or inversely as the square root of the height. Thus the bigger and the higher a tree grows the more slowly will it grow in height for a given rate of stump-growth.

These formulas may be readily tested by the age-height-diameter tables which follow.

(D) The actual height of trees on any stump-radius, during long periods of their steady growth, as related to their greatest still air height, H, on the same radius, are about as follows:

California cedars, from 80th to 380th year................ $h=0.24H$
California bigtree, from 40th to 400th year................ $h=0.24H$
California redwood (*Sequoia sempervirens*), to 40th year.... $h=0.31H$
Shortleaf pine, from 30th to 100th year.................. $h=0.32H$
Southern pines, from 40th to 180th year.................. $h=0.33H$
Michigan white pine, from 60th to 230th year............ $h=0.36H$
Pennyslvania white pine, from 40th to 230th year......... $h=0.36H$
Average American white pine, from 40th to 230th year.... $h=0.36H$
Wisconsin white pine, from 40th to 110th year........... $h=0.42H$
Wisconsin white pine, from 110th to 200th year.......... $h=0.32H$
California yellow pines, from 80th to 200th year.......... $h=0.36H$
California sugar pine, from 80th to 400th year (about).... $h=0.35H$
Tennessee white oak, from 40th to 200th year............ $h=0.36H$
Louisiana cypress (age table not available)................ $h=0.36H$
Oregon Coast Douglas fir, from 40th to 140th year........ $h=0.37H$
Oregon Coast Douglas fir, from 140th to 300th year....... $h=0.44H$
Maryland cypress, from 35 feet to 100 feet high.......... $h=0.51H$
Maryland cypress, from 100 to 130 feet, h drops from $0.51H$ to $0.36H$
(Age table not available for cypress)

"Bigtrees," popularly esteemed our tallest trees, drop steadily in relative height from youth to old age. Douglas firs behave in just the opposite way, and redwoods are not in the same class with Douglas firs for relative height. See special tables following. The tallest bigtree measured by the Forest Service was 300 feet tall on a diameter of 123 inches, whereas the tallest Douglas fir measured was 330 feet high on a diameter of only 71.6 inches.

(E) In proof of the preceding statements the following table of values of E and w will be used. It was furnished by Mr. T. R. C. Wilson, of the Government Lumber Testing Laboratories at Madison, Wis. The values of E and w were obtained from tests on small clear specimens of green material, freshly cut. The last column in this table is the value of

$$1.97\sqrt[3]{\frac{E}{w}} = H/\sqrt[3]{r^2}, \text{ by } (A)$$

and gives the numbers for the species mentioned by which to multiply the cube root of the square of the stump-radius (in inches) to obtain the greatest height, H (in feet), to which the tree could rise in still air on that radius.

Species	E	w	E/w	$1.97\sqrt[3]{E/w}$
Douglas fir	1,580,000	40	39,500	67.1
Western red cedar	950,000	24	39,583	67.1
Norway pine	1,380,000	42	32,857	63.1
Longleaf pine	1,620,000	50	32,400	62.8
Shortleaf pine	1,400,000	45	31,111	62.0
Redwood	1,060,000	38	27,895	59.8
White pine	1,070,000	39	27,436	59.4
Cypress	1,220,000	51	23,921	56.8
Western yellow pine	980,000	44	22,295	55.5
White oak	1,250,000	64	19,531	53.1

It is interesting to note, in connection with this table, that the low value of w for cedars gives Douglas firs and cedars the same number in the last column, and while the Pacific Coast Douglas fir is the most remarkable of all American trees for height, the cedar is near the bottom of the list. The cedar never rises above about one-fourth its still-air possible height, while the Coast Douglas fir at 50 years of age is a third of its still-air height, and this ratio it steadily increases for a long period, being at 110 years old four-tenths its possible height and at 180 years forty-four hundredths of its possible height, holding this ratio steadily for the next 100 years, and at 300 years of age it is still over forty-three hundredths of its possible height. The tallest Douglas fir yet measured, 330 feet high, diameter 71.6 inches, is fifty-two hundredths of its greatest possible still-air height (see (F) following). The difference in height, on the same stump-radius, between cedars and Douglas firs must be attributed to difference in energy of the terminal bud.

It will be observed in (D) that Tennessee white oaks, California yellow pines, Louisiana cypress, Michigan and Pennsylvania white pines have the same coefficient for H. This means for these trees practical equality of terminal bud energy, and that their heights on the same stump-radius are about as their numbers in the last column above, namely, 53.1, 55.5, 56.8, 59.4.

(F) The following table gives the diameters and the height of the tallest trees actually measured in the United States Forest Service lumbering operations. The figures for bigtrees were given by Mr. Woodbury, Assistant District Forester at San Francisco, those for Oregon yellow pines and Oregon Coast Douglas firs by Mr. Ames,

Assistant District Forester at Portland, and the rest by Mr. Tillotson, Acting Chief of Forest Investigations of the Forest Service.

	Diameter, inches	*Height, feet*
Red cedar	23.7	76 = 0.21 H
Bigtree	141	300 = 0.29 H
Bigtree	123	300 = 0.32 H
Bigtree	116	295 = 0.33 H
Bigtree	103	294 = 0.35 H
Cypress	29.5	125 = 0.37 H
White oak	30	126 = 0.39 H
Shortleaf pine	22.5	127 = 0.41 H
Longleaf pine	28	152 = 0.41 H
White pine	39.8	180 = 0.41 H
Oregon yellow pine	47.5	174 = 0.38 H
Oregon yellow pine	36	170 = 0.45 H
Oregon Coast Douglas fir	67.2	318 = 0.46 H
Oregon Coast Douglas fir	71.6	330 = 0.52 H

A comparison of these results with (E) and the species tables following, will show the cedar lower than the average. In the cedar table, trees 160 years old on a diameter of 23.6 inches are 86 feet high. The cypress is the Louisiana type, and lower than the Maryland sort. The white oak corresponds exactly to Tennessee trees 120 years old, 69 feet high on a diameter of 12.3 inches. The bigtrees are relatively taller (the last three) than young bigtrees. Bigtrees near 300 feet high vary from a fourth to an eighth of H. The first of the Douglas firs is, relative to H, about as the 200-year-old trees, 209 feet high on a diameter of 37.4 inches. The second Douglas fir stands at the top of the list of measured tall trees of America, both as regards actual height and height relative to H.

(G) Relatively the tallest trees (United States).

The tallest trees I have found, as compared with the greatest height H, they could reach in still air, without bending under their own weight, if tilted slightly out of the vertical, are:

	Diameter, inches	*Height, feet*
Douglas fir	71.6	330 = 0.52 H
Maryland cypress	6	61 = 0.52 H
Douglas fir	67.2	318 = 0.46 H
Wisconsin white pine	9.3	74 = 0.45 H
Oregon yellow pine	36	170 = 0.45 H
British Columbia pine, a world beater	20	221 = 0.80 H
(See note on tallest pines, under white pines.)		

(H) Forest Service Bulletins make statements concerning the greatest height and greatest diameter reached by trees of different

species. These statements do not represent actual measurements, and are hardly more than guesses. And the maximum height given does not correspond to maximum diameter. From Forest Service Bulletin 38, p. 12, it would appear that a redwood (*Sequoia sempervirens*) has reached a height of 350 feet on a diameter of 20 feet. The still-air height for a redwood of that diameter is 1,456 feet. This tree had reached one-fourth of it and would be a normal tree. See table (F). And from Forest Service Bulletin 22, p. 27, a white pine has gotten to be 200 feet tall on a diameter of 5 feet. The still-air height for a white pine of this diameter is 573.5 feet, and this tree had reached 35 hundredths of this height, and was a normal tree. See table (F). These two cases are the only ones I have found in which the diameter of the "tallest" tree was given. The tallest trees of a species are usually abnormal. I have ventured in the second column of the following table to estimate the diameter of these "tallest" trees from the behavior of the species as developed in this paper. In the fourth column I have given the still-air height for the maximum diameter.

	Maximum height, feet	*Probable diameter, inches*	*Maximum diameter feet*	*Maximum still-air height, feet*
Douglas fir	380	76	15	1,357
Redwood (*sempervirens*)	350	137	..	....
Western yellow pine	200	45	8	733
White pine	200	47	7	718
Longleaf pine	200	44	4	523
Norway pine	150	...	5	609
Cypress	150	38	12	981
White oak	150	40	8	701
Shortleaf pine	...	...	4.5	557
Red cedar	...	...	6	732

(I) Proof of the foregoing statements, other than (A), will be observed by noting the behavior of the value of the ratio of h to the cube root of the square of r, in the third column of the following tables, for the different species. This ratio keeps fairly constant over long periods for all species. And the fourth column expresses the height (h) at any time in terms of (H), the greatest still-air height for the corresponding value of r (stump-radius). Through long periods h maintains a constant ratio to H, for each species. The value of h is expressed in feet and that of r in inches, as agreed in (A).

Age	Michigan White Pine				Pennsylvania White Pine				Average American White Pine				Wisconsin White Pine			
	F. S. Bulletin 22, p. 98				F. S. Bulletin 22, p. 99				F. S. Bulletin 22, p. 93				F. S. Bulletin 22, p. 98			
	h	$2r$	$h \div \sqrt[3]{r^2}$	$h = kH$	h	$2r$	$h \div \sqrt[3]{r^2}$	$h = kH$	h	$2r$	$h \div \sqrt[3]{r^2}$	$h = kH$	h	$2r$	$h \div \sqrt[3]{r^2}$	$h = kH$
Years	*Feet*	*Inches*			*Feet*	*Inches*			*Feet*	*Inches*			*Feet*	*Inches*		
20	20	2.6	16.8	.28*H*	21	2.8	16.8	.28*H*	21.	2.5	18.1	.30*H*	22	2.2	20.7	.35*H*
40	43	7.4	17.8	.30*H*	49	8.0	19.4	.33*H*	46.	6.9	20.1	.34*H*	46	5.3	24.0	.40*H*
60	63	11.3	19.9	.34*H*	70	12.2	21.0	.35*H*	66.3	10.5	21.9	.37*H*	66	8.	26.2	.44*H*
80	80	14.8	21.1	.36*H*	86	15.5	21.8	.37*H*	82.	13.8	22.6	.38*H*	80	11.	25.7	.43*H*
100	94	17.9	21.8	.37*H*	99	18.6	22.4	.38*H*	91.3	17.2	22.5	.38*H*	91	15.2	23.6	.40*H*
120	103	20.6	21.8	.37*H*	108	21.5	22.2	.37*H*	103.7	20.6	21.9	.37*H*	100	19.6	21.8	.37*H*
140	110	23.0	21.6	.36*H*	116	24.1	22.1	.37*H*	111.3	23.7	21.4	.36*H*	108	24.0	20.6	.35*H*
160	116	25.1	21.7	.37*H*	122	26.4	21.9	.37*H*	117.3	26.3	21.1	.36*H*	114	27.4	19.9	.34*H*
180	123	27.0	21.7	.37*H*	128	28.6	21.7	.37*H*	123.7	28.7	20.9	.35*H*	120	30.5	19.5	.33*H*
200	129	28.8	21.8	.37*H*	134	30.8	21.9	.37*H*	129.	31.0	20.8	.35*H*	124	33.3	19.0	.32*H*
220	135	30.3	22.0	.37*H*	140	33.0	21.6	.36*H*	137.5	31.6	21.8	.37*H*	...	....	....	....

Average value of $h \div \sqrt[3]{r^2}$

for the last 160 years is 21.6		for the last 180 years is 21.8	for the last 190 years is 21.7
hence $h =$	$21.6 \sqrt[3]{r^2}$	$21.8 \sqrt[3]{r^2}$	$21.7 \sqrt[3]{r^2}$
$H =$ (see E)	$59.4 \sqrt[3]{r^2}$	$59.4 \sqrt[3]{r^2}$	$59.4 \sqrt[3]{r^2}$
hence $h =$	$0.36H$	$0.36H$	$0.37H$
$h^3 =$	$(21.6)^3 r^2$	$(21.8)^3 r^2$	$(21.7)^3 r^2$
$\log (h) - \frac{2}{3} \log (r) =$	$\log (21.6)$ nearly	$\log (21.8)$	$\log (21.7)$
$\log h - \log H =$	$\log (0.36)$	$\log (0.36)$	$\log (0.37)$

Age	Southern Pines, Louisiana				Shortleaf Pines				California Yellow Pines				Pacific Coast Sugar Pine			
	F. S. Bulletin 13, p. 60				F. S. Bulletin 13, p. 101				Dept. of Agr. Bull. 426, p. 28				Dept. of Agr. Bull. 426, p. 28			
	h	$2r$	$h \div \sqrt[3]{r^2}$	$h=kH$	h	$2r$	$h \div \sqrt[3]{r^2}$	$h \pm kH$	h	$2r$	$h \div \sqrt[3]{r^2}$	$h=kH$	h	$2r$	$h \div \sqrt[3]{r^2}$	$h=kH$
Years	Feet	Inches			Feet	Inches			Feet	Inches			Feet	Inches		
20	23	3.8	15.	.24H	27	5.2	17.1	.28H	12	2.3	10.9	.20H	...	...	...	...
40	48	7.	21.0	.35H	51	9.3	19.3	.31H	29	6.5	13.2	.24H	23	2.5	19.9	...
60	62	9.6	21.8	.35H	67	12.7	19.0	.31H	57	11.4	17.9	.32H	45	7.5	18.7	...
80	72	13.6	20.6	.33H	75	16.0	18.7	.30H	79	16.4	19.6	.35H	72	13.0	20.7	...
100	80	16.	20.0	.32H	81	17.0	19.4	.31H	94	20.0	20.2	.36H	92	18.1	21.2	...
120	87	18.	20.1	.32H	...	...	...	...	104	23.3	20.2	.36H	106	22.7	20.9	...
140	93	19.5	20.2	.32H	...	...	...	...	112	25.8	20.4	.37H	118	26.8	20.8	...
160	98	20.5	20.9	.33H	...	...	...	...	118	28.0	20.3	.37H	127	30.5	20.7	...
180	103	21.5	21.2	.33H	...	...	...	...	123	29.8	20.3	.37H	135	33.9	20.5	...
200	...	...	...	...	...	...	...	...	127	31.3	20.3	.37H	142	37.0	20.3	...
220	...	...	...	...	...	...	...	...	...	...	...	...	148	40.0	20.1	...
240	...	...	...	...	...	...	...	...	...	...	...	...	153	42.5	19.9	...
260	...	...	...	...	...	...	...	...	...	...	...	...	158	44.9	19.9	...
280	...	...	...	...	...	...	...	...	...	...	...	...	162	47.2	19.7	...
300	...	...	...	...	...	...	...	...	...	...	...	...	167	49.3	19.7	...
320	...	...	...	...	...	...	...	...	...	...	...	...	171	51.4	19.7	...
340	...	...	...	...	...	...	...	...	...	...	...	...	174	53.5	19.7	...
360	...	...	...	...	...	...	...	...	...	...	...	...	177	55.5	19.6	...
380	...	...	...	...	...	...	...	...	...	...	...	...	180	57.3	19.2	...
400	...	...	...	...	...	...	...	...	...	...	...	...	183	59.1	19.1	...

	Southern Pines, Louisiana	Shortleaf Pines	California Yellow Pines	Pacific Coast Sugar Pine
Average value of $h \div \sqrt[3]{r^2}$ for the last 140 years is 20.9		for the last 70 years is 19.3	for the last 120 years is 20.2	
hence $h =$	$20.9 \sqrt[3]{r^2}$	$19.3 \sqrt[3]{r^2}$	$20.2 \sqrt[3]{r^2}$	
$H =$ (see E)	$62.8 \sqrt[3]{r^2}$	$62 \sqrt[3]{r^2}$	$55.5 \sqrt[3]{r^2}$	
hence $h =$	$0.33H$	$0.31H$	$0.36H$	
$h^3 =$	$(20.9)^3 r^2$			
$\log (h) - \frac{2}{3} \log (r) =$	$\log (20.9)$	$\log (19.3)$	$\log (20.2)$	
$\log h - \log H =$	$\log (0.33)$			

Redwood				*Bigtree*				*Louisiana Cypress*				*Maryland Cypress*			
F. S. Bulletin 38, p. 23								*Dept. Agr. Bulletin 272, p. 73*				*Dept. Agr. Bulletin 272, p.74*			
h	$2r$	$h \div \sqrt[3]{r^2}$	$h=kH$	h	$2r$	$h \div \sqrt[3]{r^2}$	$h=kH$	h	$2r$	$h \div \sqrt[3]{r^2}$	$h=kH$	h	$2r$	$h \div \sqrt[3]{r^2}$	$h=kH$
Feet	*Inches*			*Feet*	*Feet*			*Feet*	*Inches*			*Feet*	*Inches*		
69	14	18.9	.32H	104	2.5	17.1	.29H	79	12.6	23.1	.41	27	2	27.0	.48H
72	15	18.8	.31H	110	3.0	16.0	.27H	91	15.6	23.2	.41	45	4	28.2	.51H
75	16	18.7	.31H	126	4.0	15.1	.25H	100	18.4	22.8	.40	61	6	29.3	.52H
78	17	18.7	.31H	143	5.0	14.8	.25H	108	21.1	22.3	.39	73	8	28.9	.51H
81	18	18.7	.31H	164	6.0	15.0	.25H	112	22.4	22.3	.39	84	10	28.7	.51H
83	19	18.5	.31H	180	7.0	14.9	.25H	115	23.8	22.1	.39	93	12	28.7	.51H
86	20	18.5	.31H	193	8.0	14.6	.24H	117	25.1	21.8	.38	101	14	27.7	.49H
88	21	18.3	.31H	206	9.0	14.4	.24H	120	26.3	20.9	.37	107	16	26.8	.47H
91	22	18.4	.31H	220	10.0	14.4	.24H	122	27.6	20.7	.36	112	18	25.7	.45H
93	23	18.2	.30H	233	11.0	14.3	.24H	124	28.8	20.4	.36	116	20	24.9	.44H
95	24	18.1	.30H	245	12.0	14.2	.24H	125	30.0	20.1	.35	120	22	24.3	.43H
97	25	18.0	.30H	254	13.0	13.9	.23H	127	31.2	19.9	.35	123	24	23.4	.41H
99	26	17.9	.30H	258	13.5	13.8	.23H	128	32.4	19.5	.34	124	25	23.0	.41H
101	27	17.8	.30H	262	14.0	13.7	.23H	129	33.6	19.4	.34	125	26	22.6	.40H
...	..	....	.....	266	14.5	13.5	.23H	130	34.7	19.1	.34	126	27	22.2	.39H
...	..	....	.....	270	15.0	13.5	.23H	131	35.9	18.5	.33	127	28	21.9	.39H
...	..	....	.....	273	15.5	13.3	.22H	132	37.1	18.6	.33	127	29	21.7	.38H
...	..	....	.....	276	16.0	13.2	.22H	133	38.2	18.4	.32	128	30	21.0	.37H
...	..	....	.....	278	16.5	13.0	.22H	134	39.4	18.2	.32	129	31	20.8	.37H
...	..	....	.....	280	17.0	12.9	.22H	135	40.5	18.1	.32	129	32	20.3	.36H
Average value of $h \div \sqrt[3]{r^2}$				14.4				20.7				25.6			
hence $h =$				$14.4 \sqrt[3]{r^2}$				$20.7 \sqrt[3]{r^2}$				$25.6 \sqrt[3]{r^2}$			
$H =$ (see E)				$59.8 \sqrt[3]{r^2}$				$56.8 \sqrt[3]{r^2}$				$56.8 \sqrt[3]{r^2}$			
hence $h =$				$0.24H$				$0.36H$				$0.45H$			
$h^3 =$				$(14.4)^3 r^2$				$(20.7)^3 r^2$				$(25.6)^3 r^2$			
$\log (h) - \frac{2}{3} \log (r) =$				$\log (14.4)$				$\log (20.7)$				$\log (25.6)$			
$\log h - \log H =$				$\log (0.24)$				$\log (0.36)$				$\log (0.45)$			

Age	Tennessee White Oak				California Incense Cedar				Pacific Coast Douglas Firs			
	F. S. Circular 105, p. 21				Dept. of Agr. Bulletin 426, p. 28				F. S. Circular 150, p. 30			
	h	$2r$	$h \div \sqrt[3]{r^2}$	$h = kH$	h	$2r$	$h \div \sqrt[3]{r^2}$	$h = kH$	h	$2r$	$h \div \sqrt[3]{r^2}$	$h = kH$
Years	*Feet*	*Inches*			*Feet*	*Inches*			*Feet*	*Inches*		
20	11	1.1	16.4	.31H	...	....	....	.....	25	4.	15.7	.23H
40	25	3.2	18.2	.34H	...	....	....	.....	64	10.6	21.1	.31H
60	38	5.3	19.8	.37H	23	6.4	10.7	.16H	93	16.2	23.0	.34H
80	49	7.4	20.5	.39H	49	9.8	16.9	.25H	118	20.5	24.8	.37H
100	60	9.7	20.9	.39H	65	13.6	18.1	.27H	138	24.3	26.1	.39H
120	69	12.3	20.6	.39H	75	17.8	17.2	.26H	157	27.4	27.4	.41H
140	74	14.7	19.6	.37H	82	21.3	16.9	.25H	173	30.0	28.4	.42H
160	79	16.8	19.1	.36H	86	23.6	17.2	.26H	186	32.6	28.9	.43H
180	84	18.9	18.8	.35H	90	25.8	16.4	.24H	198	35.	29.4	.44H
200	87	21.0	18.1	.34H	93	27.8	16.1	.24H	209	37.4	29.7	.44H
220	..	....	....	.....	96	29.8	15.9	.24H	217	39.5	29.7	.44H
240	..	....	....	.....	98	31.7	15.5	.23H	225	41.6	29.7	.44H
260	..	....	....	.....	101	33.6	15.4	.23H	231	43.6	29.5	.44H
280	..	....	....	.....	103	35.4	15.2	.23H	236	45.6	29.3	.44H
300	..	....	....	.....	115	38.2	16.1	.23H	240	47.4	29.1	.43H
320	..	....	....	.....	118	39.3	16.2	.24H	...	....	....	.....
340	..	....	....	.....	119	40.1	16.1	.24H	...	....	....	.....
360	..	....	....	.....	120	40.9	16.0	.24H	...	....	....	.....
380	..	....	....	.....	121	41.6	16.0	.24H	...	....	....	.....

	Tennessee White Oak	California Incense Cedar	Pacific Coast Douglas Firs
Average value of $h\sqrt[3]{r^2}$ for the last 170 years is 19.6		for the last 300 years is 16.3	for the last 160 years is 29.3
hence $h =$	$19.6\sqrt[3]{r^2}$	$16.3\sqrt[3]{r^2}$	$29.3\sqrt[3]{r^2}$
$H =$ (see E)	$53.1\sqrt[3]{r^2}$	$67.1\sqrt[3]{r^2}$	$67.1\sqrt[3]{r^2}$
hence $h =$	$0.37H$	$0.24H$	$0.44H$
$h^3 =$	$(19.6)^3r^2$	$(16.3)^3r^2$	$(29.3)^3r^2$
$\log(h) - \frac{2}{3}\log(r) =$	$\log(19.6)$	$\log(16.3)$	$\log(29.3)$
$\log h - \log H =$	$\log(0.37)$	$\log(0.24)$	$\log(0.44)$

NOTES ON THE MEASUREMENTS OF THE VARIOUS SPECIES

Michigan White Pine

Michigan pines remain steadily for 160 years a little over one-third the greatest height they could reach in still air on their stump diameter, while this diameter changes from 11.3 inches to 31 inches and the height from 63 to 138 feet.

The curve showing the relation between height and stump-radius of Michigan white pines for the 140 years noted here is the semi-cubical parabola

$$h^3 = (21.6)^3 r^2$$

where h is in feet and r in inches, or $\log(h) - \frac{2}{3}\log(r) = \log(21.6)$, nearly. This gives a straight line when plotted in logarithms.

Also, $\log h - \log H = \log(0.36)$.

Pennsylvania White Pine

Pennsylvania pines behave strikingly like the Michigan pines. They are somewhat taller and larger than Michigan trees of the same age, but their height relative to H is practically the same. Between the 90th and 140th year they are relatively taller than Michigan trees.

$$h^3 = (21.8)^3 r^2$$

$$\text{or, } \log(h) - \tfrac{2}{3}\log(r) = \log(21.8),$$

$$\text{and } \log h - \log H = \log(0.36)$$

Average American White Pines

Average value of $h \div \sqrt[3]{r^2}$ for 190 years is 21.7. We have for the average of New England, Wisconsin, Michigan and Pennsylvania pines, the same story as in the preceding cases, the trees showing, on the average, a little over one-third their still-air height, from the 40th to the 230th year.

The World's Tallest White Pines

The tallest white pine reported in Forest Service Bulletins is 200 feet high with a stump radius of 30 inches (Bulletin 22, p. 27).

For this tree

$$h = 20.7\sqrt[3]{r^2}$$

$$H = 59.4\sqrt[3]{r^2}$$

$$\therefore \quad h = 0.35H$$

And this tree has about the same relative height as Michigan and Pennsylvania white pines.

The tallest white pine measured by the United States Forest Service was 180 feet high on a stump-radius of 19.9 inches.

For this tree

$$h=24.5\sqrt[3]{r^2}$$
$$\therefore \quad h=0.41H$$

The tallest white pines of America, relative to their maximum possible still-air height, are those about 75 years old in Wisconsin, as shown in the table (p. 538), where trees stand 74 feet high on a stump diameter of 9.3 inches, giving

$$h=26.6\sqrt[3]{r^2}$$
$$\therefore \quad h=0.45H$$

and making this tree nearly half its greatest possible still-air height.

On comparing Wisconsin white pines with those of Pennsylvania and Michigan, it will be observed that Wisconsin trees are generally lower at the same age, while from the 40th to the 130th year they are much slenderer. Wisconsin trees stand 75 feet high on diameters a little over 9 inches, while Michigan and Pennsylvania trees of that height have diameters between 12 and 14 inches. Pennsylvania pines are the tallest and largest at same age.

The tallest pine (species not given) to which I have seen reference is mentioned by Mr. Greenhill in his paper on tall trees, as referred to in Sproat's British Columbia (1875). This tree is given as 221 feet tall on a 10-inch stump-radius. No United States tree is in the same class for relative tallness with this tree, whose still-air height would be about 275 feet. This tree had thus reached four-fifths the greatest height it could attain in still air without bending under its own weight. I would like to see this world-wonder tree![1]

Wisconsin White Pines

The value of $h \div \sqrt[3]{r^2}$ is here more variable than for any other pines I have examined. It is higher than for Michigan and Pennsylvania white pines from the 40th to the 110th year, and lower from the 160th to the 200th. It would be of interest to know what local conditions account for this. Bulletin 22 attributes the extra relative tallness of Wisconsin pines from the 40th to the 100th year to the contest for light with hardwood companions. When this contest is over, lake winds tend to retard growth.

[1] Ed. Note.—It seems more likely that these figures are estimates than that they are authentic measurements. The tree was probably a Douglas fir.

Southern Pines (Louisiana)

The tallest longleaf pine measured by the Forest Service was 152 feet high on a stump radius of 14 inches.

For this tree

$$h = 26.2 \sqrt[3]{r^2}$$

$$\text{Hence } h = 0.41H$$

This same relation holds for the tallest white pine and tallest shortleaf pine measured by the Forest Service.

Shortleaf Pine

The tallest shortleaf pine measured by the Forest Service was 127 feet high on a diameter of 22.3 inches.

For this tree

$$h = 25.5 \sqrt[3]{r^2}$$

$$\text{Hence } h = 0.41H$$

This is the same as the corresponding relation for white pines and longleaf pines.

California Yellow Pines

These pines stand, as related to the greatest height they can reach, about as Michigan and Pennsylvania white pines. They are not as tall, on a given stump radius, as the eastern trees. Their heights on a given stump radius, as compared with Michigan and Pennsylvania white pines, are about as 55.5 to 59.4, the numbers which compare their greatest heights (last column of Table E). See similar conditions with Tennessee white oaks.

Pacific Coast Sugar Pine

These pines keep all the time for 360 years about one-third the greatest height they could attain on their stump-radius.

(I have not values of E and w for these pines.)

Redwood (Sequoia sempervirens)

The table figures, p. 540, represent second growth timber and are an average for 550 trees up to 45 years old. The range of this species lies almost entirely outside the National Forests, and authentic measurements upon original growth trees are almost entirely lacking. Bulletin 38 says that this species of Redwood (different from the Bigtree, *Sequoia washingtoniana*) is the tallest of American trees, giving 350 feet on a 20-foot diameter as the limiting size. It seems to me that Douglas firs should be classed as our tallest trees. Mr. Donald McDonald, General Manager of the Pacific Lumber Co., mentions a tree 69 feet

in circumference at the stump, 161 feet to the first limb where the diameter is 11.5 feet, and "estimated" to be about 300 feet high. It is regrettable that reliable information about these trees is so meager.

The third column of the table shows a fairly steady, but slowly decreasing, value from the outset. I thought this due to the fact that these are second-growth trees. Stump shoots make a rapid growth at first, but it seems characteristic of redwoods. The bigtree behaves in the same way, as also Louisiana cypress. The Douglas fir behaves in just the opposite way for two hundred years. (See the Douglas fir table.)

$$h = 18.4 \sqrt[3]{r^2}$$
$$H = 59.8 \sqrt[3]{r^2}, \text{ by } (E)$$
$$\text{Hence } h = 0.31H$$

Thus redwoods of this species are, for the first 45 years of their growth, about three-tenths of their still-air height. The McDonald tree (above) is about one-fifth its still-air height. The 350-foot tree was about one-fourth its still-air height.

Bigtree (*Sequoia washingtoniana*)

The estimates in the table, p. 540, were made in 1904. They were given me by Mr. Woodbury, Assistant District Forester at San Francisco.

Bigtrees from about the 50th to about the 500th year of age are about one-fourth their still-air greatest possible height.

Relatively the tallest bigtree I have found is a tree 294 feet high with a diameter of 103 inches. See section (E) and the following section. This tree is thirty-five hundredths of its greatest possible height.

The tallest and biggest bigtrees.—The tallest bigtrees actually measured by the United States Forest Service up to the present time are (according to Mr. Woodbury):

Total height, feet	*Diameter breasthigh outside bark, inches*	*Merchantable height, feet*
$300 = 0.32H$	123	275
$300 = 0.29H$	141	275
$295 = 0.33H$	116	265
$294 = 0.35H$	103	270

These trees are thus about one-third their greatest still-air height. These are not the tallest trees in the Sequoia National Park, but the tallest actually measured by the Forest Service. The tallest of the

recorded trees of the Park is 319 feet high (Fry and Welch). Mr. Woodbury gives 325 feet as the highest bigtree of authentic record. Forest Service Bulletin 38 says there are redwoods, *Sequoia sempervirens*, 350 feet high. The diameters of these trees above 300 feet are not recorded.

The Circular, "The Sequoia National Park," gotten out by the Department of the Interior, gives 275 feet as the average height for favorably situated trees having a diameter of 20 feet, and states that trees 25 feet in diameter and approaching 300 feet high are not rare. These trees are about one-fifth the still-air height.

The stump diameter for bigtrees is an uncertain criterion. It is generally very much swollen. The diameter about 12 feet from the ground would be best suited for mathematical consideration. Above this the diameter is well sustained.

The biggest bigtrees are:

General Sherman	Sequoia National Park
General Grant	General Grant National Park
Grizzly Giant	Yosemite National Park
Boole Tree	Converse Basin
Abraham Lincoln	Sequoia National Park
California	Sequoia National Park
George Washington	Sequoia National Park

The following measurements are given in The Sequoia National Park:

	Height, feet	*Diameter, feet*
General Sherman	280	36.5
General Grant	264	35.
Abraham Lincoln	270	31.
California	260	30.
George Washington	255	29.

Mr. Woodbury gives the following measurements:

	Circumference at base	*Circumference 10′ up*	*Circumference 12′ up*	*Height, feet*
General Sherman	103′	.....	82′ 4″	280
General Grant	107.4′	.....	69′	264
Grizzly Giant	93′ 7″	64′ 6″	.....	204
Boole Tree	109′ 8″	77′	.....	No record

These trees are more remarkable for size than for height. They are roughly about one-eight to one-sixth their greatest possible height in still air.

Louisiana Cypress

Trees less than 125 feet high are relatively slightly taller than white pines. Those higher than this are relatively lower than white pines.

Maryland Cypress

The Maryland cypresses are when young and less than 115 feet high relatively taller, as compared with the greatest height they can attain in still air, than Douglas firs, and are relatively the tallest trees I have found. The tree 61 feet high on a 6-inch diameter is 0.52 of the greatest height possible, and is as tall a tree, relatively, as the Douglas fir 318 feet high, diameter 67.2 inches.

The fact that the diameters all progress in arithmetic series, with a difference of one inch, gives these trees a somewhat "academic" appearance.[2]

Tennessee White Oak

It will be observed, on comparing them with Michigan and Pennsylvania pines, that white oaks are as tall, on a given stump radius, as compared with the greatest height they can reach on that radius, as are pines. However, it takes the white oak 200 years to acquire a stump diameter of 21 inches which the pines referred to reach in about 90 years. White oaks cannot stand as high on a given stump as can white pines. It is interesting to observe that the height of white oaks on a selected stump radius, as compared with the height of Michigan and Pennsylvania pines on the same radius, are about as 53.1 to 59.4, the numbers in the last column of the first table (E) as comparing the greatest heights attainable on any stump radius.

The Tallest White Oak

The tallest white oak stood 150 feet high. On what diameter I do not know. The tallest found in Forest Service lumbering operations was 126 feet high with a stump-radius of 15 inches.

For this tree $h = 20.6 \sqrt[3]{r^2}$ which is relatively the same as at 120 years in the table.

---

[2] Ed. Note.—This is because a table showing height based on diameter has been used in this case. In most of the other cases, Professor Bohannan has used growth or yield tables which show diameter on age, height on age, and hence indirectly height on diameter.

California Incense Cedar

These incense cedars are only about one-fourth the height they could reach in still air.

The tallest cedar of the Forest Service lumbering operations, 76 feet high on a stump diameter of 23.7 inches, was not as high as the 160-year old trees of the table, p. 541, on the same diameter. The highest tree here is higher than the height given for the maximum height in the height table.

Pacific Coast Douglas Fir

Both as relates to actual height and height relative to H, the Douglas fir is the most remarkable of American trees. Unlike the redwood the value of $h \div \sqrt[3]{r^2}$ steadily increases up to the 200th year. Its average value from the 70th to the 140th year is 25.4 and the average from the 140th to the 300th year is 29.3.

For the tallest Douglas firs measured by the Forest Service, see section (F).

Proof of the Formulas in (A)

Imagine that the trunk of the tree has the form of a tall cone tapering to a point and of small constant angle. Take the origin of coordinates at the vertex, x-axis vertically downward, y-axis horizontal. Let (x, y) be any point on the neutral axis, (x', y') any other point between (x, y) and the top, W the weight of the tree above (x, y), E the modulus of elasticity, I the moment of inertia of cross-section. Imagine the tree tilted slightly out of the vertical.

$$\frac{EI\frac{d^2y}{dx^2}}{\left(1+\left(\frac{dy}{dx}\right)^2\right)^{3/2}} = \int_0^x (y'-y)\,dW$$

If we assume that $\frac{dy}{dx} = p$ is small compared with unity, then

$$EI\frac{dp}{dx} = \int_0^x (y'-y)\frac{dW}{dx}\,.\,dx, \text{ nearly.}$$

or,
$$E\frac{d}{dx}\left(I\frac{dp}{dx}\right) = -p\int_0^x \frac{dW}{dx}\,dx = -pW$$

Here $I = \frac{\pi t^4 x^4}{4}$, where t is the tangent of the half angle at the vertex.

And if w is the weight per unit volume, $W=\frac{1}{3}\pi t^2 wx^3$

$$\therefore\ E\left(\pi t^4 x^4\frac{d^2p}{dx^2}+4\pi t^4 x^3\frac{dp}{dx}\right)+\frac{4}{3}\pi t^2 wpx^3=0$$

or
$$x\frac{d^2p}{dx^2}+4\frac{dp}{dx}+cp=0 \tag{1}$$

where
$$c=\frac{4W}{3\,t^2E}$$

(1) is the differential equation of the neutral axis when the tree is tilted slightly out of the vertical, under the primary supposition that *p is at all points small as compared with unity.* This equation can be solved only in series form.

If $p=x^m$, (1) gives:

$$m(m+3)x^{m-1}+cx^m=0 \tag{2}$$

Thus there are two ascending series which will satisfy (1), one beginning with x^0 and the other with x^{-3}. The latter cannot be used, since we have agreed that p is to be small as compared with unity for all values of x; p would be infinite in this series for x equal zero.

If $y=\Sigma A_n x^{m+n}$ then by (2)

$$(m+n)(m+n+3)A_n+cA_{n-1}=0 \tag{3}$$

For $m=0$,
$$A_n=\frac{c}{n(n+3)}A_{n-1} \tag{4}$$

(4) gives as a solution of (1),

$$\therefore\ p=A_0\left(1-\frac{cx}{1.4}+\frac{(cx)^2}{1.4.2.5}-\frac{(cx)^3}{1.4.2.5.3.6}+\text{etc.}\right)$$

$$=A_0\left(1-\frac{1}{4}\,\frac{cx}{1}+\frac{1}{4.5}\cdot\frac{(cx)^2}{\lfloor 2}-\frac{1}{4.5.6}\cdot\frac{(cx)^3}{\lfloor 3}+\text{etc.}\right) \tag{5}$$

(5) is evidently convergent.

Assuming p equal zero when x is H, we have as the equation determining the greatest still air-height of a cone, not bending under its own weight,

$$0=1-\frac{1}{4}\cdot\frac{cH}{1}+\frac{1}{4.5}\,\frac{(cH)^2}{\lfloor 2}-\frac{1}{4.5.6}\cdot\frac{(cH)^3}{\lfloor 3}+\text{etc.} \tag{6}$$

This expression has its smallest root between 10 and 11. A close approximation is

$$cH=10.2$$

But $c=4w\div 3t^2E$, where $t=r\div H$

$$\therefore\ H=\sqrt[3]{7.65\,\frac{E}{w}\,r^2}$$

$$\text{or,}\quad \frac{H}{\sqrt[3]{r^2}} = 1.97\sqrt[3]{\frac{E}{w}}$$

as in (A).

For trees growing as cylinders, as do some palms, the differential equation (1) of the neutral axis becomes

$$\frac{d^2p}{dx^2}+cxp=0, \tag{7}$$

where $c=4w\div Er^2$, w being the weight per cubic foot and r the radius.

This equation can be solved only in series form. If we assume $p=x^m$, then (7) gives

$$m(m-1)x^{m-2}+cx^{m+1}=0 \tag{8}$$

(8) shows that (7) has two series solutions, one beginning with x^0 and the other with x, consecutive powers differing in exponent by 3. It is needless to get the second series, for $\frac{dp}{dx}$ is to be zero when x is zero.

If we assume

$$x=\sum_{n=0}^{n=\infty} A_n x^{m+3n}$$

(8) gives

$$(m+3n)(m+3n-1)A_n.+cA_{n-1}=0$$

$\therefore$ for $m=0$,

$$A_n=-\frac{c}{3n(3n-1)}A_n-1$$

$\therefore$ the only usable solution of (7) is

$$p=A_0\left(1-\frac{c}{3.2}x^3+\frac{c^2}{3.2.6.5}x^6-\frac{c^3}{3.2.6.5.9.8}x^9+\text{etc.}\right)$$

$$=A_0\left(1-\frac{1}{2}\left(\frac{cx^3}{3}\right)+\frac{1}{2.5}\cdot\frac{1}{\lfloor 2}\left(\frac{cx^3}{3}\right)^2-\frac{1}{2.5.8}\frac{1}{\lfloor 3}\cdot\left(\frac{cx^3}{3}\right)^3+\text{etc.}\right)$$

This series is evidently convergent. If we assume p is zero when x is H, we have for determining the height of the cylindrical column the smallest positive root of the following, where $Z=\frac{cH^3}{3}$

$$0=1-\frac{1}{2}\frac{Z}{\lfloor 1}+\frac{1}{2.5}\cdot\frac{Z^2}{\lfloor 2}-\frac{1}{2.5.8}\cdot\frac{Z^3}{\lfloor 3}+\text{etc.}$$

This root lies between 2 and 3. A close approximation is

$$3Z=cH^3=7.815$$

where

$$c=4w\div Er^2$$

$$\therefore H=\sqrt[3]{1.95\frac{E}{w}r^2}$$

or
$$\frac{H}{\sqrt[3]{r^2}}=1.25\sqrt[3]{\frac{E}{w}}$$
as in (A).

The bole a paraboloid of revolution.

If we assume that the bole of the tree has the form of a paraboloid of revolution, with the equation,
$$r^2=8mx$$
the neutral axis, as in the foregoing cases, has the equation
$$\frac{\pi}{4}E\frac{d}{dx}\left\{r^4\frac{dp}{dx}\right\}=-wp\pi\int_0^x r^2dx,$$
$$\therefore\ 4mE\frac{d}{dx}\left\{x^2\frac{dp}{dx}\right\}=-wpx^2$$
$\therefore$ differentiating, dividing by x, and letting $xp=Z$, we have the linear equation,
$$\frac{d^2Z}{dx^2}+\frac{w}{4Em}Z=0$$
$$\therefore\ Z=xp=A\sin\left\{\sqrt{\frac{w}{Em}}\cdot\frac{x}{2}\right\}$$
$\therefore$ for $p=o$, the height (greatest) is given by,
$$\frac{H}{2}\cdot\sqrt{\frac{w}{Em}}=\pi$$
And if r is the stump radius,
$$r^2=8mH$$
$$\therefore\ H^3=\frac{\pi^2}{2}\cdot\frac{E}{w}\cdot r^2$$
$$\therefore\ \frac{H}{\sqrt[3]{r^2}}=\sqrt[3]{\frac{\pi^2}{2}}\cdot\sqrt[3]{\frac{E}{w}}$$
$$=1.71\sqrt[3]{\frac{E}{w}}$$

SITE DETERMINATION, CLASSIFICATION, AND APPLICATION

By Russell Watson

University of Michigan; late Forest Assistant, U. S. Forest Service

In the Proceedings of the Society of American Foresters for October, 1916, is a note by Mr. Rechnagel which is apropos Mr. Roth's article on Sites which appeared in the Forestry Quarterly, Vol. XIV, pp. 3ff. Mr. Rechnagel desires to search out the relationship which may exist between the site classification in use in the United States and that in use in Europe. He asks if our Site II corresponds to the Site II in Europe, and, if it does not agree, wherein does it differ, and, if it does not altogether differ, wherein does it agree?

It is patent that if there were any standard of site classification in this country it could be compared to that in Europe, provided the methods of measuring site were the same on both continents, inasmuch as the site classification in Europe (or at least in Germany) is well standardized. Furthermore, in Europe sites are standardized to all ways of measuring site. So it is apparent that the reason that Site II in the United States cannot be compared to Site II in Europe is because there is no standard site in the United States. That there is no standard site classification in the United States is a pretty sad commentary; that there should be one is certain.

It is the purpose of this article to indicate a possible standard method of site determination and of site classification. In order to test the validity of the methods herein advocated, they are applied in a practical manner to a timber survey.

The determination of sites is very important in forest management, since the site is an important factor in deciding upon the species which may be used to best advantage, the yield tables which may be applied, the rotation which may be used, and the method of regeneration which may be followed. The most important of these points in relation to site is the yield tables which may be applied. Should we make yield table for every possible site? Should we make yield tables for every species? Should we apply the same yield table to the species no matter where it may grow, or should we make a new yield table for it in every locality where it grows?

How vital these questions are is not realized until one begins to collect and coordinate data on those species that range over wide areas. How does the western yellow pine in Arizona compare to that in central Oregon? How does the white pine in New Hampshire compare to that in Minnesota? What is the relation between the growth of cottonwood on the river bottoms of Wisconsin and that in Missouri?

In many cases, even trees upon which a great deal of study and investigation have been spent, it is utterly impossible to make satisfactory comparisons of growth between two regions. The reasons for this are not hard to find.

The present lack of system in site classification and determination is a jumble in several ways. In the first place, investigators differ as to the classification of sites in a given locality making two, three, and up to seven or more sites. Investigators differ also in the methods of determination of site, for although one determines site by the volume per acre of even-aged stands at a certain age, another uses as the criterion the height of dominant trees at a certain age; still another uses the chemical and mechanical qualities of the soil, while a fourth measures site by a formula site factor which is founded upon the basal area per acre, age of stand, and height of average tree. Finally, some investigators apparently simply declare one site as good and another as poor, and base yield tables accordingly.

It is evident that the result can be nothing but the inevitable existing confusion. It is, then, for us to determine a standard method of measuring site; and, having this determined, to scheme a frame upon which sites may be classified for reference and relationship.

TO DETERMINE A STANDARD MEASURE OF FOREST SITES

A standard measure of forest sites should be a measure which is sensitive to changes in site; which is applicable equally to mixed and to pure forests; which is applicable equally to even-aged and to uneven-aged stands; which is applicable to any sized unit of area; which is simple and not laborious in application; which is not affected by the density of the stocking of the stand, and which is cosmopolitan in scope With reference to these points, a few of the more common methods of determining site are discussed.

Medwiedew's Method—On the north Pacific Coast a modificatioı of the method of Medwiedew (a Russian forester) has been advocated The method proposed is to obtain a site factor by multiplying the basa

area of the average acre of the stand (in square feet) by the height of the average tree of the stand (in feet) and dividing by the average age of the stand; or, in formula, site factor $= \frac{c \times h}{n}$. This works out when applied to Hanzlik's tables of Douglas fir about as follows:

		Site Factors	
Age	*Site I*	*Site II*	*Site III*
20	223	145	. . .
60	470	355	79
100	522	368	105
140	518	353	127

The advocates of this method claim that for the north Pacific Coast region if the formula works out to over 400 that the site is good; that when the result is between 300 and 400 the site is medium, and that if the result falls below 300 the site is poor.

It is noticed that in the above table the site at 140 years (under Sites I and II) is slightly poorer than at 100 years. If now a stand of timber is taken—hypothetical but not at all unusual in the Northwest—about as follows: Basal area per acre, 400 square feet; height of average tree, 250 feet; age of average tree, 350 years, then the site factor per formula is 285 and the stand is classified as Site III, inasmuch as 285 is less than 300. If Site III in the Pacific Northwest supports trees that are 250 feet tall, we shudder to think how the trees on Site I are pestered by the clouds. It is evident that in this formula the site varies with the age of the stand, for neither the basal area of the stand nor the height of the trees increases in constant ratio with the age. But, of course, site is not predicated upon the age of the stand it supports.

Medwiedew's method lacks in several other essentials. The basal area per acre and the height of the trees practically determine the volume per acre of the stand, and it is certain that the determination of site by volume per acre cannot be used in broken stands. Again, if the method were to be faithfully followed out it would be laborious of application.

Nor would the system be applicable to uneven-aged stands; for what is the average height and age of the trees in an uneven-aged stand? The method would be reduced to a basis of age on diameter and from diameters to heights; and the question arises upon what site

the volume tables were made. Granted that one knew the site upon which the volume tables were made, it would mean computing out the method for all sites before finding the application of the volume tables.

It would appear that Medwiedew's method, as modified, can be eliminated from the list of competitors.

Soil classification is used to some extent in the determination of site, and theoretically this method is correct. For tree growth is certainly dependent upon certain definite factors of growth, and, given these factors, why should not the determination of the site be based on determining the amounts of these factors in the site? The answer is because the determination of these factors is too technical, too laborious, and too complex for general use. The great number of factors which influence tree growth make a complexity of conditions that is impossible to analyze. There is climate with its temperature and rainfall and humidity; there are the physical and chemical conditions of the soil, and each is determined only at much expense and time. The practical field work would require, among other things, the boring of deep holes with soil augurs, the labeling and carrying of little samples of earth, their value determinations later, and the coordination of these samples. The investigator would have to make an investigation of the drainage conditions. Besides, these investigations of the factors which control tree growth are not yet well enough done and the effects of the factors are not yet sufficiently well known to interpret their meaning with much certainty. Even the best investigations of farm land give results which are known to be quite uncertain as to value.

All in all, however, this method of determining site by the *cause* of site rather than by the *effect* of site (as other methods aim to do) is too complex and tedious for practical woods work.

The *volume yield* of a definite area of even-aged stands is the most generally accepted criterion of site quality. The method comes from Europe, except that the foresters in the United States use volume as measured by the indirect and unsatisfactory board foot instead by the cubical contents, as is done abroad. That the volume yield of stands as a criterion for site is not adapted to wild woods work is easily shown.

Any measure which depends upon a set unit of area (as an acre) for its application cannot be used in the wild woods where the stands are badly broken and hardly any two areas contain the same amount of timber, and despite the fact that the two areas have different amounts

of timber the site may be the same. A windfall or an insect attack may remove half the timber on an area in a year, and this would accordingly halve the site quality. A fully stocked stand would give one volume, and hence determine a site; whereas an understocked stand would give less volume, and hence be determined as a poorer site.

Again, the yield in volume is applied to an even-aged stand, and how can this be applied to the forest which is often composed of irregular sized patches of even-aged and uneven-aged material and every possible combination of ages and stocking possible?

Finally, how could this method be used in a mixed forest, where the site may be first class for one species but second class for another species?

A *single tree* in the stand may be selected for the determination of site. It has the advantage that it does not depend upon any definite unit of area, is equally good in pure or in mixed forest, in wild woods, or in artificial woods, in even- or in uneven-aged stands, and is probably as sensitive to site changes as is any measure.

The form of a tree is generally expressed by either its height, its diameter, its form factor, or a combination of these three into its volume. The results of site on a tree may therefore be expressed either by any one of the above or any of their combinations.

The *diameter* of a tree as an expression of site is not satisfactory, for the reason that it does not respond strongly to site in actual measurable amounts. The form factor of a tree does vary somewhat with the site upon which the tree is growing, but its use as an expression of site cannot be recommended, due to the uncertainty of the value of the expression and to the laboriousness of the work entailed in determining it.

The *height* of a tree is often used to determine site. The height is affected to some extent and in some cases by density of stocking; for if the stand is so densely stocked that more or less stagnation of growth results, then, of course, the height growth of the tree is reduced appreciably. But this does not often occur so severely that the height cannot be used.

It is said, in general, that a tree which is grown in the open is not so tall at the same age as a tree which is grown in the forest. In the forest, it is argued, the tree is forced to climb for light through competition, and is thus forced into a more rapid height growth. This may be true to a slight extent, but given the same site it is doubtful.

The use of the height of a tree for the determination of site should be done by using a dominant tree in the stand which is of some definite age, say, 100 years.

A *résumé* of the foregoing indicates that any method which uses in its site determinations a definite amount of land surface—as an acre—is not satisfactory, since it is seldom that the wild woods are fully stocked over areas of the size required in the determinations. It is considered that the determination of site by the factors of growth (soil, climate, etc.) is ordinarily impossible on account of the cumbersomeness and uncertainty of the method. It is believed that Medwiedew's method of site factors is ordinarily not advisable for wild woods work.

Finally, it has been shown that as a criterion of site the height of a single dominant tree offers fewer objections than any of the other methods proposed. The height of a dominant tree is a sensitive measure of site, it is easily obtained, and it is practically the only measure of site which can be used in the broken, mixed, wild woods forests.

If, then, the measure of site shall be the height of a sound, dominant, healthy tree at a definite age, the next step in the forwarding of the purpose of this article is to determine some simple, applicable system of site classification.

CLASSIFICATION OF SITES

There are a number of salient requisites to be observed in constructing a system of site classification:

1. The classification should be adapted to the forest conditions of the country. There should be no site or tree species left out.

2. It must be arbitrary within limits. Sharp lines simply have to be drawn.

3. It must be based upon nature.

4. It must be simple.

In addition, the following principles should also guide:

1. The largest figure must show the growth of the tallest tree of the species; the smallest figure must show the growth of the smallest tree of commercial importance in the country.

2. As there is a great range and gradations between the tallest and the shortest trees, it naturally follows that the figures representing the growth of trees other than the tallest and shortest must be arbitrarily chosen.

3. As the growth conditions of regions are often well marked, and as the growth of the individual trees is well marked, the range of figures from the greatest to the least may be conveniently divided into groups, the groups to represent regions or species.

4. The groups should be subdivided in such a way that each subdivision will represent a natural site distinction. It would be confusing to divide that group which represents the rapidly growing trees of the north Pacific Coast into sites which differ only by 10 feet, since in that region two trees, although of the same species, dominance, age, and growing on similar sites, may have a variation of that much in their height. Similarly, it would be confusing and incorrect to divide that group which represents Arizona into sites which differ by twenty-five, inasmuch as 25 feet might cover the actual difference in the heights of tree on two or more sites. A consistency must be kept between the sensitiveness and the value of the criterion of site and the number of sites in the group.

The result of these principles is a division of the growth conditions of the country into *groups of similars,* and these groups are divided into natural arbitrary divisions which represent the individual sites of the group.

The system of classification given below is frankly patterned after that system advocated by Roth in his article in the Forestry Quarterly, March, 1916. Mr. Roth divides the trees of the country into three groups, as determined by their growth in height; the present system uses six groups. Mr. Roth's division of the groups into four sites is adopted here.

The following is the system of site classification advocated:

	Heights of Dominant Trees at 100 *Years of Age*					*Height at* 40 *Years*
Sites	*Group A*	*Group B*	*Group C*	*Group D*	*Group E*	*Group F*
I	150	125	100	75	50	75
II	125	105	85	65	45	65
III	100	85	70	55	40	55
IV	75	65	55	45	35	45

In the above system Group A includes the Douglas fir, western hemlock, and Sitka spruce of the Pacific Coast.

Group B will include the sugar pine, white fir, and western yellow pine of the west side of the Sierra Mountains of California. It will also probably include some of the loblolly pine of the South.

Group C will include the jack pine of the Lake States, white and Norway pines, longleaf pine, and, in some regions, western yellow pine.

Group D will about cover the Rocky Mountains, Idaho, Utah. Arizoña.

Group E will do for the spruce and balsam of Canada, for the pinon and mesquite of the Southwest, for the scrub oak in the North and South, for blue beech, etc.

Group F is intended to take care of those trees—such as cottonwood on the river bottoms, loblolly pine on old fields, etc.—which make an extraordinarily rapid growth during youth, but which is not maintained. As a result of this rapid growth during youth, the rotation, which will be used in handling these species, will probably be set low; and it is desirable that the age, which is used in the determinations of site, is set near the rotation. For these reasons, the age of determination is set, not at 100 years, as in all other groups, but at forty years. This figure is based upon such meager information as is at hand, but it is believed to be approximately correct.

In all other cases the age of determination is placed at 100 years. This figure is determined upon not only because this is standard in Europe but also because most trees are holding pretty steadily to their height growth up to this age, as was found by comparing and examining the growth of trees from different parts of the country.

In order to determine the applicability of this system of grouping, the heights of western yellow pine trees at 100 years were obtained from many regions throughout the West and divided according to the system proposed. The figures were obtained from many sources, and since the quality of site upon which the trees grew was seldom mentioned in the tables, it was considered that they grew on sites which were better than the average of the region. The figures are, therefore, referenced to Site Quality II:

Height of Western Yellow Pine Trees in Different Regions. Age, 100 *years.*

Region	*Height in Feet*
Central Oregon	43
Crook County, Oregon	48
Prescott National Forest, Arizona	53
Apache National Forest, Arizona	54
Black Hills, South Dakota	56
Whitman National Forest, Oregon	58
Sisters, Oregon	59
Montana	66
Klamath, Oregon	69
Wasco County, Oregon	70
Union County, Oregon	79
Stevens County, Washington	100
Butte County, California	114

Separating these regions in accordance with the grouping proposed, we find that California and Washington fall into Group B; Union County, Oregon, into Group C; Whitman, Montana, and Klamath, into Group D, and the remainder fall into Group E. This grouping is merely for illustration; more and better data are needed before a final classification can be done.

The illustration indicates that this method of grouping is cosmopolitan and perfectly adaptive.

It is seen that the classification and grouping are merely a measure for comparisons of tree growth in the various regions. It appears to us to be as good and as handy a measure as is available.

APPLICATION OF THE SYSTEMS AND METHODS OUTLINED

The following description of the application of the methods outlined for the determination and classification of sites is based upon the methods used by the United States Forest Service in its timber surveys:

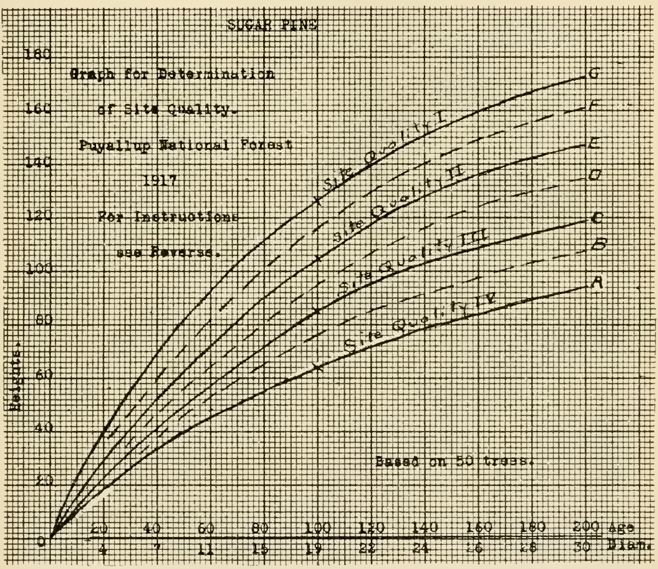
The first thing to be done is to group the area which is being cruised according to the grouping system outlined. Usually there are available growth tables which show the growth on at least the best sites of the area. This is all that is required to accomplish the grouping, since it is very doubtful if the growth on the poorest site will be less than that which is indicated by the site classification. The sites intermediary between the best and the poorest fall into their places mechanically, according to the classification. But if there are no growth tables, or if they are not considered satisfactory, then a dozen healthy, dominant trees, approximately 100 years old, growing on representative sites, may be cut, and they will give the data required for the grouping.

After having determined the group to which the area belongs, the next step is to construct curves of height growth based on age and diameter for each species. The trees for analysis should not have irregular butts, should be dominant or co-dominant, healthy and preferably neither overmature nor yet saplings. The trees used in the determination of the grouping may be used.

Draw a curve of the growth in height on Site I. The curves of the growth in height on the other sites will follow it in general shape, but as far distant below the first curve as the classification indicates. These curves of growth do not need to be based on a great many measurements; it is very probable that entirely sufficiently accurate figures can be obtained by the use of an increment borer and hypsometer, if the trees are not too large.

In the example given, trees on Site I are 125 feet tall when 100 years old. They therefore fall into Group B. Trees on Site II are then, according to the site classification, 105 feet tall at 100 years; on Site III they are 85 feet tall, and on Site IV they are 65 feet tall. These figures thus determine the location of the curves at the 100-year point.

It is believed that it may safely be assumed that on the average the diameter varies with the age of the tree. All diameter limit planning presupposes this. So on these curves the diameters are written in under the ages to which they correspond.



At present, in most of the Forest Service timber survey work, trees are tallied not only by diameters but also by their merchantable height. As a result, by the use of a constant figure of addition, the total height may be obtained within an error of a very few feet. Or the estimator may occasionally determine not only the merchantable length of the tree but also the total height. It is evident that the estimator is continually obtaining the data necessary for the determina-

tion of site qualities. The determination of site quality is done as follows:

The height and diameter of the tree are determined. Locating the diameter of the tree on the abscissa of his site quality graph and the height of the tree on the ordinate, the estimator runs up from the diameter and across from the height, and that site quality curve which is nearest to the intersection of the two coordinates is the site quality of the area.

A sample graph is illustrated on page 561.

The instructions on the reverse of the graph are as follows:

TO THE ESTIMATOR

You have determined the height and D.B.H. of the tree,
To Find the site quality:
If the tree is over 30 inches D.B.H. then—
Site I—Trees over 160 feet tall;
Site II—Trees between 135 and 160 feet tall;
Site III—Trees between 110 and 135 feet tall;
Site IV—Trees under 110 feet tall.

If the tree is between 8 inches and 30 inches D.B.H. then—
Run up on the diameter ordinate, and
Across on height abscissa, and
The intersection is the site quality.
If the intersection falls:
Above Curve *F* the site is I,
Between *F* and *D* the site is II,
Between *B* and *D* the site is III,
Below Curve *B* the site quality is IV.

If the diameter of the tree is less than 8 inches, then the site quality is determined by analogy, using topography, soil, moisture, general health and growth of the trees.
In determinations always use thrifty, uninjured, dominant or co-dominant trees, preferably not growing in dense stands.

It is believed that after two weeks of the work the estimator will be able to determine the site quality with as little mental effort as he uses in determining the number of logs per tree.

On the estimate sheet should be printed a diagram which is divided into either two or four parts, depending upon whether the cruise is 5 per cent or 10 per cent (if 5 per cent, the diagram is divided into two parts; if 10 per cent into four parts). This diagram represents the forty being cruised. When the estimator arrives at the end of the forty (or division of forty) he glances over the heights and diameters which he has obtained, uses his graph to determine the site quality of the area covered, and records in the proper part of the diagram the site quality—I, II, III, or IV, as the case may be.

That evening in camp, when the party chief checks off the day's accomplishment, he checks the forties off by the site numbers. Every forty, or division of forty, that has a site number on it thus has been cruised. In this manner both accomplishment and site are represented by a single figure.

The camp topographer then orients the site map (which is on tracing vellum) over the site-and-accomplishment sheet, which was prepared by the party chief (see above), and writes in the sites.

The sites are now bounded by straight lines, but this is not as they are in the field. To correct this, the topographer orients the site map over the topographic map, and, with the topography to guide him, smooths out the site boundaries. He may now color in the sites.

Cost.—Since the preparation of growth curves is a work that should be done on every forest, this cost should not be charged entirely to the cost of the site mapping. The work of the camp topographer is practically the only item whose cost can be directed against the operation. This should not be more than 1/25c. an acre. The time consumed by the estimator in his determinations is believed to be negligible.

Certainly this cost is nominal under any circumstances, but when it is further considered that good forest regulation is impossible without a site map, this cost appears to be amply justified.

CONCLUSION

It has been pointed out that there is no standard method in the United States for the determination or the classification of sites. The need of standardized methods is shown.

In order to arrive at the best method for the determination of site, the advantages and disadvantages of the more common methods in practice are discussed. It was found that the best criterion of site quality is the height of a dominant tree.

Since there is not in use any standard method of site classification, a method is suggested which was originally advocated by Roth. This classification divides the trees of the country into six groups, and each group is divided into four sites.

In order to test the validity of the classification, it is applied to western yellow pine. The classification is found to be adaptive to this widely ranging species.

To test the workability of the methods advocated, a feasible scheme of application is described. The application is found to be simple, sufficiently accurate, and cheap.

THE SWISS METHOD OF REGULATING THE CUT IN PRACTICE

By C. H. Guise, M. F.

Instructor in Forestry, Cornell University

In a recent issue of Forestry Quarterly an article appeared which aimed, as the author expressed it, "to show how Pressler's well known formula may be used in a practical way to determine the current annual increment in mixed selection forest, and from this to work out the regulation of the cut.[1] Data secured while making working plans in both the Catskill and Adirondack Mountains were used in determining the current annual increment. With the data at hand, the regulation of the cut was worked out by what is known as the Swiss Method.[2]

The conservative and satisfactory results obtained by the use of the Swiss Method led to its employment in determining the allowable cuts for two tracts of forest land, for which the writer made working plans during the past year.

These two tracts were alike in only one respect—both were covered with mixed selection forest.

One of the working plans was made for the forest lands on a private estate in the western part of the Catskill Mountains.[3] The area of the tract was 2,612 acres. Beech, yellow birch, sugar maple, and hemlock made up over 90 per cent of the timber, on the mountain slopes. A very large portion of the timber was overmature and well over the diameter corresponding to the determined technical rotation, in this case 16 inches d. b. h.

The other working plan was prepared for a tract of land, 3,734 acres in extent, owned by the State of Wisconsin.[4] This property, known as the Peninsula State Park, is a rounded parcel of land, projecting from the mainland of Door Peninsula into Green Bay. In contrast to the rugged topography of the Catskills this area is, with the exception of several small bluffs, entirely flat and covered with the typical mixed forests of the Lake States. White pine, red pine, balsam, cedar, hem-

[1] A. B. Recknagel, "A Practical Application of Pressler's Formula." Forestry Quarterly, Vol. XIV. No. 2, pp. 260–267.

[2] A. B. Recknagel, "Theory and Practice of Working Plans." (Second Edition, 1917.) John Wiley & Sons, N. Y., pp. 74–77.

A brief of this method also appeared in Forestry Quarterly, Vol. XIII, pp. 260–262.

[3] This estate is located in the Denning Tract, Town of Denning, Ulster County, New York. A copy of the working plan is on file at the Department of Forestry, New York State College of Agriculture, Cornell University, Ithaca, N. Y.

[4] This Working Plan will soon be published by the State Conservation Commission of Wisconsin.

lock, beech, paper birch, maple, basswood, ash, oak, and the popples are all found in considerable quantities, both in mixtures and in pure stands of varying sizes. In further contrast to the forests of the Catskills the greater proportion of the timber, both in number of trees and volume exists in the size classes up to and including 16 inches d. b. h. A relatively small proportion of overmature stock is on hand.

TABLE 1.—Current Annual Increment Per Cents. Pressler's Formula. $P=\frac{V-v}{V+v}\times\frac{200}{n}$.[1] Ulster County, New York.

[*Read from Curves*]

	Hemlock		*Beech*		*Birch*		*Maple*	
D.B.H. Inches	*Years to grow 1 inch d. b. h.*	*C.A.I. per cent*	*Years to grow 1 inch d. b. h.*	*C.A.I. per cent*	*Years to grow 1 inch d. b. h.*	*C.A.I. per cent*	*Years to grow 1 inch d. b. h.*	*C.A.I. per cent*
6	6	....	12	....	10	....	12	....
7	7	7.19	10	....	10	....	10	....
8	8	4.30	11	....	10	....	10	....
9	8.5	4.00	11	....	10	....	10	....
10	9	2.69	11	....	9	....	10	....
11	9.75	2.68	12	....	10	....	10	....
12	10	2.26	12	....	9	....	8	....
13	10.50	2.08	17	1.90	18	4.68	8	4.75
14	11	1.75	17	1.23	9	3.03	8	2.18
15	11.25	1.55	21	.77	8	1.94	8	1.64
16	11.50	1.69	23	.54	9	1.22	8	1.59
17	12	1.48	26	.40	9	1.46	8	1.47
18	12.25	1.24	27	.48	7	2.19	6	1.46
19	12.50	1.10	..	....	9	1.60	7	1.35
20	12.75	.97	..	....	7	2.45	7	1.49
21	13	.89	..	....	8	1.35	6	1.99
22	.....	....	..	....	8	1.15	6	1.73

[1] V= volume at certain diameter in inches; v= volume at next smallest diameter in inches; n= number of years to grow this inch in diameter.
Hardwood tables begin at 13 inches, hemlock at 7 inches d. b. h. The volume tables used are listed on pages 6 and 7 of Bulletin 11, New York State Conservation Commission.

In order to use the Swiss method to regulate the cut two sets of data must be had; first the volumes of existing material, and second, the current annual increment per cent. The former is secured from the stock tables of the working plan; the latter by the use of Pressler's formula[5] or some other means of determining the current annual increment per cent.[6]

Tables 1 and 2 present the current annual increment per cent, the

[5] See Table 1.
[6] *E. g.*, Schneider's formula or the methods described by B. A. Chandler in For. Quart., Vol. XI, No. 3, pp. 453–460 and J. G. Stetson, For. Quart. Vol. VIII, No. 3, pp. 326–331.

TABLE 2.—*Current Annual Increment Per Cents, Door County, Wis. Pressler's Formula.*

[Read from Curves]

D. B. H. inches	*Balsam*[1] Years to grow 1 inch d. b. h.	*Balsam*[1] C. A. I. per cent	*White pine*[2] Years to grow 1 inch d. b. h.	*White pine*[2] C. A. I. per cent	*Red pine*[3] Years to grow 1 inch d. b. h.	*Red pine*[3] C. A. I. per cent	*Hemlock*[4] Years to grow 1 inch d. b. h.	*Hemlock*[4] C. A. I. per cent	*Beech*[5] Years to grow 1 inch d. b. h.	*Beech*[5] C. A. I. per cent
6										
7	10	3.23	5.0	6.66	4.5	....	9.50	....	11.0	4.95
8	13	2.86	5.5	6.41	4.5	....	9.00	....	11.5	3.48
9	15	2.43	5.4	6.10	5.0	6.06	8.25	2.80	12.5	3.08
10	15	2.24	5.9	5.86	5.5	6.00	10.00	3.19	11.5	2.82
11	17	1.76	5.5	5.13	5.0	3.13	8.50	3.29	11.5	2.44
12	17	1.56	5.7	3.73	6.5	3.12	9.00	3.07	11.5	2.26
13	18	1.26	5.7	3.44	6.5	2.60	9.00	2.77	11.5	2.16
14	..	....	6.3	3.09	7.0	2.59	9.00	2.22	12.0	1.94
15	..	....	6.3	2.87	8.0	1.82	9.25	2.04	12.0	1.63
16	..	....	6.7	2.49	8.0	1.23	10.25	1.65	12.0	1.51
18	..	....	15.6	1.79	19.0	0.98	20.50	1.52	26.0	1.27
20	..	....	22.5	1.18	30.0	0.72	24.00	1.21	28.0	.86
22	..	....	....	....	....	....	33.00	.78	....	....
24	..	....	....	....	....	....	33.00	.39	....	....
28	..	....	....	....	....	....	....	....	....	....

Birch[6]		*Maple*[7]		*Basswood*[8]		*Ash*[9]		*Popple*[10]		*Oak*[11]	
Years to grow 1 inch d. b. h.	*C. A. I. per cent*	*Years to grow 1 inch d. b. h.*	*C. A. I. per cent*	*Years to grow 1 inch d. b. h.*	*C. A. I. per cent*	*Years to grow 1 inch d. b. h.*	*C. A. I. per cent*	*Years to grow 1 inch d. b. h.*	*C. A. I. per cent*	*Years to grow 1 inch d. b. h.*	*C. A. I. per cent*
8	5.00	11.0	....	7.00	....	6.00	6.96	5.5	10.53	7.0	7.82
8	3.87	10.0	....	6.75	....	6.00	6.71	5.5	8.30	7.0	6.00
12	2.13	10.0	4.00	7.00	6.90	5.75	6.53	7.5	4.60	7.0	4.82
14	1.61	10.0	2.86	6.50	6.69	5.25	6.15	7.5	3.59	7.0	3.66
20	1.05	10.5	2.53	7.00	5.04	5.25	5.65	9.0	2.66	7.0	3.52
20	1.03	10.0	2.43	6.25	4.17	5.50	4.80	15.0	1.28	8.0	2.65
24	.83	10.0	2.22	7.00	4.01	5.50	4.34	....	.....	8.5	2.56
24	.78	10.0	1.93	8.00	2.88	5.00	4.13	....	.....	9.5	2.11
..	....	11.0	1.29	7.50	2.63	6.00	3.33	....	.....	10.5	1.99
..	....	10.5	1.26	8.00	2.33	....	....	....	.....	11.5	1.71
..	....	24.0	1.18	17.00	1.82	....	....	....	.....	25.0	1.48
..	....	24.0	1.00	20.00	1.33	....	....	....	.....	27.0	1.04
..	....	24.0	.93	24.00	1.32	....	....	....	.....	29.0	.81
..	....	....	....	26.00	1.06						
..	....	....	....	46.00	.95						

[1] Growth from Table 15, Bul. 55, U. S. D. A.
[2] Growth from Table 4, Bul. 13, U. S. D. A.
[3] Growth from Table 6, Bul. 139, U. S. D. A.
[4] Growth from Table 8, Bul. 152, U. S. D. A.
[5] Growth from Table 7, Bul. 285, U. S. D. A.
[6] Growth from Table 58, Bul. 36, U. S. F. S.
[7] Growth from Table 7, Bul. 285, U. S. D. A.
[8] Growth from Table 7, Bul. 285, U. S. D. A.
[9] Growth from Table 9, Bul. 299, U. S. D. A.
[10] Growth from Table 58, Bul. 36, U. S. F. S.
[11] Growth from Table 59, Bul. 36, U. S. F. S.

For Volumes used see Appendix of Working Plan for Forest Lands of Peninsula State Park, Wisconsin Conservation Commission, Madison, Wisconsin.

former for the timber growing in the Catskills, the latter for the timber on Peninsula State Park. The data in Table 1 were not made for the Catskill tract under discussion, but for a parcel of State land but a short distance away.[7] Similarity of forest and site conditions warranted the use of these data for the working plan in question.

Time was not available for growth studies on the Wisconsin Park, and for this reason growth tables best suited for that part of the state were used. Reference to the source of growth tables will be found in Table 3. The current annual increment per cents were curved in each case.

To illustrate the methods of dividing the volumes and the increment therein into the group divisions necessary to the use of the Swiss Method, Table 3 is presented. This shows by diameter the volume and increment, both in per cent and in board feet, therein, for the hemlock in the Catskill tract.

TABLE 3.—*Hemlock (Catskill Mountains)*

D. B. H. inches	*Volume on average acre—board feet*		*Current annual increment—per cent*	*Current annual increment—board feet*	
6					
7					
8	8.27	*X*	4.30	.356	*Xi*
9	9.48		4.00	.379	
10	18.17		2.69	.489	
11	18.03		2.68	.483	
12	22.38		2.26	.506	
13	21.05		2.08	.438	
14	30.04		1.75	.525	
15	36.98		1.55	.573	
16	35.17		1.69	.594	
17	43.28	*Y*	1.48	.641	*Yi*
18	43.25		1.24	.536	
19	36.85	*Z*	1.10	.405	*Zi*
20	22.41		.97	.215	
21	12.84		.89	.114	
22	23.38				
23	24.93				
24	29.65				
25	12.41				
26	4.59				
27	10.12				
Totals	474.40			6.254	

Diameter limit—16 inches d. b. h. Maturity limit—18 inches d. b. h.

[7] Bulletin 11, New York State Conservation Commission; "A Forest Survey of a Parcel of State Land," Albany, N. Y., 1915. For. Quart., Vol. XIV, No. 2, "A Partial Application of Pressler's Formula," p. 261.

The same diameter classes were chosen for each of the species in the Catskills, 16 inches d. b. h. below which no sound and thrifty timber should be cut and 18 inches d. b. h. as the maturity limit above which the timber is growing so slowly as to be judged overmature.

The diameter and maturity limits are not uniform for the various species in the Peninsula State Park. Since pulp wood can be cut from smaller trees than can saw logs, the diameter limits are bound to vary. The maturity limit was fixed where the current annual increment falls below 2 per cent.

The technical rotations and the diameter limits for the species on both tracts of land can be seen from Tables 4 and 7.

Although several methods were used in determining the cut for each working plan, the results obtained by use of the Swiss Method were given the most weight, and the other methods merely used as checks. Tables 4 and 5 show the relative volumes of the size classes ("Y" and "Z"), the increments ("Xi" and "Yi"), the length of cutting cycles,[8] and the allowable annual cuts as determined by the use of these data in the Swiss method. It will be remembered that the cutting cycle here is the number of years during which the volume of the oldest size classes must last, and is obtained by dividing the volume of the older size classes by the annual increment of the forest.[9] With this in mind, the reason for the difference in length of cutting cycles for the two tracts of forest is readily apparent. The volume of timber in trees over the diameter limit and under the maturity limit (class "Y"), and the increment on classes "X" and "Y" ("Xi" and "Yi") will determine the number of years in the cutting cycle. Where there is a large amount of timber in class "Y," and a relatively low increment, a long cutting cycle is found to result. This condition is found in the forests of the Catskill tract. Beech and birch are examples of cutting cycles of average length. With the hemlock there is a relatively high increment in proportion to the amount of timber in class "Y," and the result is a shorter cutting cycle. With the maple the conditions and results are reversed.

---

[8] The varying lengths of cutting cycles in the two tracts of timber are perhaps the most noticeable features in Tables 4 and 5.

[9] $CC = \frac{Y}{Xi + Yi}$. The surplus growing stock "Z" should play no part in determining the cutting cycle, "CC," (F. Q. XIV, No. 2. p. 264).

TABLE 4.—*Allowable Annual Cut Determined by the Swiss Method—For 2,356 Acres of Selection Forest, Ulster County, New York*

Species	*Xi* Bd. Ft. per A	*Y* Bd. Ft. per A	*Yi* Bd. Ft. per A	*Z* Bd. Ft. per A	*Cutting cycle · Years*[1]	*Allowable annual cut per acre Bd. Ft.*[2]	*Allowable annual cut. Entire tract Bd. Ft.*	*Annual cut reduced 20 per cent for defect. Bd. Ft.*
Hemlock......	4.34	86.53	1.17	188.30	15	17.50	39,230	31,384
Beech........	7.13	242.43	1.04	392.76	30	21.42	50,465	40,372
Birch.........	5.02	379.92	6.68	469.85	30	26.55	62,550	50,040
Maple........	3.88	590.66	9.41	1100.41	45	38.08	89,720	71,776
Total........						103.55	241,965	193,572

[1] $CC = \frac{Y}{Xi + Yi}$.

[2] Annual cut $= \frac{Y + Z}{CC}$

TABLE 5.—*Allowable Annual Cut Determined by the Swiss Method. For Peninsula State Park, Door County, Wisconsin*

Species	*Xi* Bd. Ft.	*Y* Bd. Ft.	*Yi* Bd. Ft.	*Z* Bd. Ft.	*Cutting cycle, years*	*Allowable annual cut, by Swiss method. Bd. Ft.*
Balsam	5,373	8,653	81	......	1.5	5,769
White pine	14,706	108,149	2,247	......	6.4	16,900
Red pine	8,679	23,230	272	......	2.6	8,934
Hemlock	37,792	309,550	4,741	8,230	7.3	43,531
Beech	21,617	56,810	844	......	2.5	15,907[1]
Birch[2]	5,803	31,942	333	16,338	5.2	9,284
Maple	22,995	109,800	1,376	37,440	4.5	26,000[2]
Basswood	3,034	45,160	915	15,520	11.5	5,276
Oak	6,645	131,386	1,941	30,000	15.3	10,584
Ash	1,555	All trees under rotation size.				
Popple[3]	7,965	24,475	357	1,700	2.9	9,026

[1] Reduced 30 per cent for defect.
[2] Reduced 20 per cent for defect.
[3] Volumes in cubic feet.

With the various species in the forests on the Peninsula State Park, very short cutting cycles were obtained in every case. A relatively high increment and very little timber over the diameter limit is responsible for these conditions. Balsam with a cutting cycle of 1.5 years and oak with a cutting cycle of 15 years represent the extremes here.

Results from both tables show clearly that with the use of the Swiss method, where a large amount of material under the diameter limit exists, the tendency is toward a short cutting cycle; because the large amount of timber in this class will be growing most rapidly and hence furnishing a large amount of volume increment; and that a large amount of material in class "*Y*" in proportion to the amount in class "*X*" will tend to lengthen the cutting cycle.

Two extremes are shown in the data in Tables 4 and 5. While the character of the size classes has caused wide variations in the length of the cutting cycles for the two forests, they have had no similar influence on the allowable annual cuts, when determined by the method under discussion.

In the working plan for the Catskill Tract, the results by the Swiss method were checked with Von Mantel's formula and the area method. For the Peninsula State Park land, results secured by Von Mantel's formula, and Hufnagl's method, Var. I (summation of increment), were used as checks. The results secured and their averages are shown in Tables 6 and 7.

It will be noted that the Swiss method gives results in all cases higher than the average. Inspection of the tables will show that the average is pulled down by the results of Von Mantel's formula.

The reason why Von Mantel's formula gives such low results is because it assumes that the actual growing stock is like the normal growing stock for purposes of determining the cut, that is, since [10]$nV = \frac{ri}{2}$ then $i = \frac{nV}{\frac{r}{2}}$, and letting $V = nV$, and Y (the allowable cut) $= i$, then $y = \frac{V}{\frac{r}{2}}$. But the actual V is not equal to $\frac{r}{2}$, since much of the stock is above rotation age, and the increment on these overmature trees is usually less than that at rotation age.

In the Catskills, the cuts determined by the Swiss method are close to those obtained by the area check, although with the exception of birch, more conservative. The cause of the low results obtained by Von Mantel's formula has been explained.

In Table 7, the second (preferred) variation of Swiss method will be found to give slightly higher results. This is due to the fact that the first (original) form of the method is merely a summation of the current annual increment, while the second variation of the method provides for the annual disposal of a certain amount of overmature timber, during the first cutting cycle. The exception occurring with the white pine and red pine results from the fact that there is considerable actual increment ("*Zi*") in the class of timber over the maturity limit ("*Z*"). This increment "*Zi*" is not used in working out the second variation of the Swiss method. The closeness of results obtained with these two variations is noticeable with each species. Von Mantel's method gives low results here, as it does in Table 6, and for the same reason. Beech, maple, and hemlock show the largest differences, and it is in these species that the larger amounts of overmature timber occur. In the other species the results are not so much at variance as in the species listed in Table 6.

In forests of the kinds for which the two working plans were made the use of Von Mantel's method would not be advocated except as a check. Conservative results are always obtained, and where forests are as abnormal as these, Von Mantel's formula is very likely to give abnormal results.

---

[10] $nV = \frac{ri}{2}$, when nV = normal growing stock, r = rotation in years, and i = mean annual increment.

TABLE 6.—*Comparison of Allowable Annual Cut Computed by the Swiss Method, Von Mantel's Formula and the Area Check on 2356 Acres of Selection Forest, Catskill Mountains, Ulster County, New York*

Species	Rotation years[1]	Corresponding d. b. h. inches	IV Swiss Method Ft. B. M.	II Von Mantel's method Ft. B. M.	I Area[2] Check method Ft. B. M.	Average of three methods. Ft. B. M.
Hemlock..	140	16	31,384	12,760	32,890	25,678
Beech.....	240	16	40,372	27,650	44,420	37,481
Birch.....	160	16	50,040	30,175	49,270	43,161
Maple....	180	16	71,776	43,425	84,060	66,420
Totals....................			193,572	114,010	210,640	172,740

[1] Technical rotation—*i. e.*, years required to reach 16 inches d. b. h.

[2] Cut $=\frac{A}{CC}\times$ amount to be removed per acre, where CC = cutting cycle, and A = area of forest.

NOTE.—The roman numerals refer to the numbers of the methods in "Theory and Practice of Working Plans," Second edition, John Wiley & Sons, N. Y., 1917.

TABLE 7.—*Comparison of Allowable Annual Cut as Determined by both Variations of the Swiss Method, and by Von Mantel's Method, on 3,374 Acres of Selection Forest, Peninsula State Park, Door County, Wisconsin*

Species	Rotation Years[1]	Corresponding d. b. h. inches	Allowable annual cut, Bd. Ft. Var. II Swiss	Var. I method	Von Mantel's method	Average
Balsam........	120	12	5,769	5,454	4,582	5,268
White pine.....	85	15	16,900	16,953	10,719	14,857
Red pine.......	85	15	8,934	8,951	6,682	8,189
Hemlock.......	160	15	43,531	42,580	22,069	36,060
Beech..........	180	14	15,907	15,723	6,649	12,759
Birch[2]	70	10	9,284	6,241	7,854	7,793
Maple.........	170	14	26,000	19,753	10,527	18,760
Basswood......	100	14	5,276	4,105	2,637	4,006
Oak...........	100	14	10,584	8,595	7,554	8,911
Ash............	100	15	......	1,555	603	719
Popple[3]	55	10	9,026	8,322	5,962	7,770
Totals...........................			151,211	138,232	85,838	124,093

[1] For discussion of methods see Recknagel, "Theory and Practice of Working Plans," Second edition, John Wiley & Sons, New York, 1917. Var. I of the Swiss Method takes $CC=\frac{Y+Z}{Xi+Yi+Zi}$ and annual cut $=\frac{Y+Z}{CC}$. Var. II of the Swiss Method takes $CC=\frac{Y}{Xi+Yi}$ and annual cut $=\frac{Y+Z}{CC}$.

[2] Technical Rotation.

[3] Volumes in Cubic Feet.

Insufficient data are at hand to warrant positive statements regarding facts which can be obtained by the use of the Swiss method. Yet the results obtained and shown in this article, together with those secured previously, would certainly warrant its further use in regulating the cut in mixed selection forests.

THE PROBLEM OF MAKING VOLUME TABLES FOR USE ON THE NATIONAL FORESTS[1]

By Thornton T. Munger

Forest Examiner, Forest Service

The measurement of the volume of a standing tree is a difficult operation, but a most necessary one for the forester. It is fundamental to the management of a forest property, and is, therefore, a phase of forestry which has received much attention. In a brief paper it will not be possible to go into the intricacies of the problems that confront us in making volume tables for National Forest use, but I should like to call attention briefly to the part that the Branch of Research should play in the preparation of volume tables, to sketch some of the questions that arise in their preparation, and to suggest some of the principles that, it seems to me, should guide the work. I hope that in the discussion to follow we may have an interchange of views that will throw much needed light on this subject and show the way to constructive improvement in our volume-table practice.

The difficulties in the measurement of standing trees arise not only because most of the tree is out of reach and because there are so many of them but because no two trees are alike, and because they are not of a regular geometric shape. If the used portions of trees were regular in shape and their volume followed some mathematical law, we investigators would probably not be concerned with a study of the principles of volume-table construction. It would merely be for the mathematician to tell us the shape of the tree, and the problem of measuring standing trees would be settled. For years there has been an effort to find a rule of thumb by which the volume of any tree could be arrived at, but all rules of thumb and formulæ require measurement which it is not convenient to make, and are, therefore, impractical in actual use. Measurements of the contents of individual standing or down trees can be secured very accurately by careful instrumental measurement of the bole of the tree. This is practicable only for detailed scientific work, such as in volume-growth or yield studies. The present discussion is concerned merely with the preparation of

[1] Paper read at the Forest Investigations Conference in Washington, D. C., March 1, 1917, slightly revised.

board foot tables which may be used in the measurement of a large number of trees, as in timber survey work.

In timber estimating as practiced on the National Forests the volume table is one of the forester's most necessary tools. He needs a good diameter tape, or calipers, or Biltmore stick, a good hysometer, and a good volume table. So far I feel that, rather inevitably, our American volume tables are of the rough stone era in forestry. It is now time, it seems to me, for the scientific branch of the Service to equip the administrative officers with better volume tables, good tools with which to do their timber estimating. I feel that this is work for the Branch of Research rather than for the Administrative Branch of the Service, because, as I have already said, volume-table preparation is not straight, simple mathematics. It involves principles which have not yet been worked out. There is field for the investigators in searching for the best principles of volume-table preparation, in standardizing volume-table practice, in inventing the much-wished-for universal volume table.

The next question is, What is the matter with our present volume tables? Then, What must be done to secure an ideal set of tables?

An examination of our tables show that they are as variable in construction as they are numerous. Some are based on merchantable height; some on total height. Some assume utilization to a fixed top diameter; others conform to actual utilization practice, with every gradation between. Some are discounted for defect and breakage; others are based on sound, normal trees only. Some assume a standard stump height; others are indefinite on this point. Some are based on measurement at regular 16-foot intervals; others are from measurements taken almost at random up the bole of the tree. Some are based on young and old trees jumbled together, and are, therefore, really applicable to neither young or old timber, or, similarly, are made from measurement of trees from several types, and therefore perhaps not accurate in any one type. Most of them are based on the Scribner rule, the adopted scale rule of the Forest Service; in this particular there is general conformity.

Tables as variable as this are really safe only in the hands of the maker, for unless the construction of a table is understood by the user he will apply it unintelligently and probably erroneously. Unfortunately, we have very little information to show how accurate our tables are. Where discrepancies in our estimates have been found, the errors have been ascribed more often to errors in the allowance for

defect or breakage, to errors in the width of the survey strip, height measurement, or some other easy source of error in crusing. Because volume table defects have been overshadowed by the other perhaps larger and more easily corrected sources of error in timber surveys, I believe we have somewhat neglected the careful study of volume table preparation.

American foresters have been confronted with a tremendous problem in supplying themselves with volume tables for the hundreds of species of the country and for the wide range of conditions under which some of our trees grow. In Europe, with only a half-dozen commercial species, it is no wonder that each table can be based on 50,000 trees. In this country we have been forced to use a volume table on one species which was made for another without any knowledge of the relative form factors of the two species, or, for lack of a better, we have put into general use a little local volume table made for temporary use only.

While volume tables are altogether lacking for some species, there is duplication with other species. This duplication comes partly from the independence and isolation of the districts, each of which desires to make its own tables without collaboration or reference to its neighbors. It also comes from the practice—which, I think, is now less common—of each cruiser making tables for each project, namely, local tables.

Granted, then, that there is room for improvement in the volume-table system on the National Forests, and that the Branch of Research should assume responsibility for making these volume tables, what kind of tables are wanted and how should they be made?

The first point that must be decided is whether we should adhere to the conventional form of table or whether we should adopt a radically different form. By conventional form of table I mean one which shows the contents in board feet, or cubic feet for specialized purposes, of trees of various diameters and of various heights. Whether the conventional form of table or a radically different form is used depends basically upon the method of timber estimating to be employed. If experienced estimators of the type of the high-paid private cruiser are to be used, it would clearly be best to have volume tables which show the contents of trees by component logs and which give the taper for each log—tables which permit of grading the timber as it is estimated; quality of volume tables. But if inexperienced estimators are em-

ployed, as in the case of the field assistants used on our timber surveys, then a simple, conventional form of volume table is preferable.

One type of table used by experienced cruisers on the Pacific Coast is based on diameter inside bark above the root swell, on merchantable height, and on the rate of taper per log. It is a theoretic table, in that it is prepared in the office merely by assuming the required set of diameters and height and a series of tapers and then applying the corresponding scale for each log in the tree. Such a table is, of course, absolutely correct if the tree or group of trees to which it is applied corresponds to the assumed dimensions and taper. It presupposes, however, a uniform taper throughout the length of the merchantable stem, and this is not true to life usually; hence the table is theoretically slightly off. A table like this has very great advantages. It is a universal table in a sense, in that one table will do for all species. Its cost of construction is almost nothing, for it requires merely an adding machine for a few days to make one that would do for all species for all time. It has several disadvantages for Forest Service use. Since it is based on three variables, it would complicate tallying on the survey strips to such an extent as to make it impracticable so long as we continue to tally each tree—a practice which I think we want to continue. It also requires the exercise of nice judgment in estimating taper—a judgment which the high-paid professional private cruiser has, but which the field assistants used on our timber surveys have not. In short, a table of this kind cannot well be fitted in with our established methods of timber surveys.

Another type of table is Schenck's "Cruisers' Tables." These are based on four variables—diameter inside bark at top of butt log, number of logs, taper, and mill factor of efficiency. These tables have an advantage over the tables previously described in being practically correct, universal in application; but they also have the disadvantage of being impracticable to use where individual trees are tallied and of being worthless in the hands of a field assistant who has not trained judgment. It is my opinion, however, that our present system of cruising, which requires the tallying of every tree by size, demands the use of a table built along the lines of our present conventional tables.

If we decide to continue to use volume tables of the general style now in use, it is very desirable that there be systematization and standardization throughout the districts. I do not mean that there must be a rigid model to which all volume tables must conform and that

individual and local requirements must be unintelligently sacrificed for the sake of system, but I do believe that the Branch of Research can take even the existing data and find out the principles of tree form of the American species, make better tables than we now have, and eliminate further duplication. This must be done naturally in collaboration with the Administrative Branch of the Service, which is to use the tables. It is for the latter Branch to define what it wants, and then for Research to go ahead and make it.

There are a number of questions as to the system to be adopted that will arise at the very start, and I should like to outline some of them. Those which I will speak of in turn are the following:

1. Local vs. general volume tables.
2. Normal or forest-run trees as the basis.
3. Allowance for defect.
4. The diameter basis.
5. Total vs. merchantable height.
6. A fixed or a graduated top diameter.
7. The length of the sections.
8. The assumed stump height.

Local vs. General Volume Tables

I spoke a minute ago of the practice of some of the cruisers in the Forest Service of making local volume tables for each separate project. This practice is now less common than a few years ago.

Such tables were based on a few trees, and in them was inculcated the cruiser's individual method of cruising—the intensity of utilization that he assumed for that job, the local defectiveness that was culled etc. These local tables were undoubtedly excellent for the maker's use in the one locality, but should not have been used by anyone else or in any other locality. With the large amount of cruising that the Forest Service is doing, it strikes me as a great extravagance to make local volume tables, though something can be said for their superiority for local use and their fitness for a particular job. The Service is now pretty well committed to standard volume tables, namely, volume tables based on a large number of trees from various localities. I believe that this is good policy, and that if the tables follow a carefully worked out plan, as discussed below, standard tables for broad regions will work very well.

There is undoubtedly a limit to the applicability of a standard table,

and there is indication that in Service practice so-called standard tables have been applied to too widespread and too variable types of timber. District boundaries alone seem to have been the limit for standard tables. Age classes and types should be the criterion of the application of tables. It is too well known to need more than mention here that a second-growth, 24-inch, 100-foot tree has a very different form from an old-growth tree of the same dimension, or a tree on rich bottom land from a tree of the same size and species on a rocky ridge. A change of soil or of age may make more difference in tree form than 1,000 miles of geographic position. I do not believe that the Service has taken sufficient account of this in making its standard volume tables. It is necessary that Research should make a study of tree form, probably by working out stem form factors from existing data so as to determine what are the variables. To see, for example, how different is the form factor for old-growth western yellow pine for a certain class of site in Arizona from what it is in the Sierras or Black Hills or Blue Mountains, to see whether the variation with age is material, to see to what extent quality of site affects the form factors and what the law of the variation is. After a study of this kind has been made, it may be decided that there should be six form classes for western yellow pine; for example, one to include first quality old growth in California and Oregon, another second quality in this region and first quality in other regions, another young bull pine and black jacks for all regions, etc. In Norway I understand that three site classes, or form classes, are used for the spruce volume tables, besides height and diameter classes.

Shall Normal or Forest-run Trees Be the Basis for a Table?

The selection of the trees to be measured has always been a matter of discussion. Shall broken tops, "schoolma'ams," and the like be included in the proportion in which they exist in the forest, or shall only normal and regular trees be selected? This is a question which must be worked out by the investigators and the administrative men and some uniform policy decided upon and adhered to. This matter of normal vs. forest-run trees is apart from the question of sound vs. defective trees, which I shall take up next.

Allowance for Defect

Some of the local volume tables have been constructed to allow for defect and breakage. This may be all right for local volume tables to

be used only by the maker, but for standard volume tables this practice is indefensible. Some allowance must be made anyway by the cruiser for the variable amount of defect that occurs in all stands, and it is much better that he should make it all. This view is generally accepted, I believe.

The Diameter Basis

It has been Forest Service practice to base the tables on the diameter at breast height outside the bark. This is unquestionably the easiest measurement to take. With some species, however, the root swell extends more than 4½ feet up the tree; hence I would not recommend holding universally to this height. With Sitka spruce, a very much buttressed tree, District 6 based the table on the diameter at a point 1 foot above the pronounced root swell. Commercial cruisers commonly estimate the stump diameter; some of them use the diameter above the pronounced root swell.

There is one important point of difference between private cruising and Forest Service methods, and that is the former always considers the diameter inside the bark and the latter that outside. With a species such as Pacific Coast Douglas fir, that may have a bark 5 inches thick or only 2 inches, depending on site, I am inclined to believe that a large source of error is introduced in having standard volume tables based on measurements outside the bark. Perhaps for some heavy-barked species it would be best for the estimators to tally the diameter inside the bark and have the tables constructed accordingly.

Total vs. Merchantable Height

There is a long-standing controversy as to whether the height classes in a volume table should be expressed in total height or merchantable height. I assume that all tables to be constructed hereafter will be based on heights as well as diameters. Some of the districts have settled this controversy by printing their volume tables both ways. The advantages and disadvantages of each method about offset each other. Personally, I feel that for most western conifers the top of merchantability can be determined with the eye or with the hypsometer about as accurately as the top of the tree, and that the moderately careful estimator is as apt to get his trees in the proper merchantable height class as in the proper total height class. The former—merchantable heights—is certainly the more convenient classification and more

in accord with cruising practice. Professor Chapman has pointed out[2] that the use of total height tables will forestall the cruiser's error in assuming a different intensity of stem utilization from that assumed by the maker of the table, but it is not clear to me that this would be so in practice.

I will leave this interesting point to be decided by those who perhaps may later study the subject more deeply, with a view to standardizing our practice.

A Fixed or a Graduated Top Diameter

A volume table may be made with a fixed top diameter limit—say, 8 inches—for trees of all sizes, or it may assume a graduated top diameter limit coincident with actual utilization, namely, a low limit, 8 inches for the small trees and a larger one for the big trees. If a fixed top diameter limit is used, the cruiser must add enough to his allowance for breakage and wastage to make up for the portion of the tip between the actual used point and the 8-inch point. In a recent article Professor Chapman has pointed out that it is the natural tendency for a cruiser to take his merchantable length merely to the actual point of merchantability, even if he is using a table of a smaller fixed top diameter, and, furthermore, that the error so introduced into his cruise is much greater than the scale of the tip so ignored. A large error is introduced by his tallying a tree in a lower height class than it belongs, for it gives it a different shape and volume throughout its lower logs. He, therefore, strongly recommends a graduated top diameter, based on actual logging practice. There is this to be said, however, that the volume table maker would have to use his judgment in determining that actual merchantable point and his judgment might not agree with the cruiser's. Perhaps it is better to give the volume table maker no latitude and tie him down to some definite point. It should be as easy for the cruiser to conform to this practice and estimate the height to a point at an absolute fixed top diameter as to an hypothetical point at the top of merchantability.

The Length of the Sections

In the construction of most Service tables the measurement of the bole has been taken at 16-foot intervals and the top of the tree divided into shorter lengths, in accordance with our scaling practice.

[2] Proceedings Society of American Foresters, Vol. XI, No. 2, p. 221.

In the region in which 32-foot logs are standard the volume tables have been made accordingly. The difference in the length of the sections makes a good deal of difference in the scaled volume. For example, where the taper per log is 2 inches, there is a difference in the scale of two 16-foot and one 32-foot log of from 3 to 16 per cent, depending on its diameter. Hence it is important that the length of the sections be systematic, that it be as closely as possible coincident with the Forest Service practice and that the system used be set forth in the table itself.

The Assumed Stump Height

The height of stump which the volume table assumes is a minor consideration, but is one which should be standardized for each set of measurements and stated in the table itself. It is apparent that if in making the table the volumes of the trees are so calculated as to include the stem to a point 6 inches above the ground and the trees are actually to be cut to a 2½-foot stump, an error in estimating of several per cent will result. Other particulars in which standardization is necessary will undoubtedly occur to you, as, for example, whether it would be feasible to construct tables that would take account of overrun, as proposed by H. E. McKenzie.

CONSTRUCTION OF TABLES

After it has been decided what form our standard volume tables shall take and what policies shall guide the selection of the trees to be included in each table, the next matter to take our attention is the method of making the table. You have probably all had a hand in making a volume table or two by the conventional method, *i. e.*, the method of measuring a number of down trees, grouping the trees by diameter and height classes and securing the scaled volume of each section, adding the trees of each group together and curving and recurving the results. The striking thing about this method is the large number of trees required to strike consistent and harmonized averages

This is merely a method of comparing a lot of felled trees, which are actually measured, with another lot of standing trees which are out of reach. Its reliability depends on the principle of averages.

If our volume tables were to be expressed in cubic feet instead of in board measure, it is probable that some such formula as Schiffel's ($V = H\ (.16B + .66b)$) could be used to good advantage in measuring the felled trees, because it is so much quicker than the laborious

Smalian Formula method, and since it is based on a law of form, it would probably require less trees to get a smooth table than the conventional method.

In this country, it appears, however, that we are going to want our volume tables in the board foot unit for some time to come, and board foot measure does not lend itself easily to formulæ or to the ordinary form factors which are useful short cuts in making cubic measure volume tables. My discussion, therefore, is limited to preparation of volume tables expressed in the board foot unit.

Recently, in several articles, Bruce has explained a method, the frustum form factor method, of constructing a table which promises to give good results from fewer trees. In brief, this method consists of determining the ratio between the scaled contents of a tree and a frustum of a cone of equivalent basal and top diameter and height. The ratios thus secured are averaged,—and they seem to run very uniformly even for a small number of trees—and then applied to the base table of frustums of cones of all needed dimensions. The final form of the volume table is identical with the conventional table. Several of the districts, perhaps all of them, have tried out this short-cut method and reported favorably upon it. I think there is a field for Research in investigating it still further. It is particularly important to determine whether these factors are constant for virgin and overmature timber, where the laws of form are less regular than with young timber. In Europe stem form factors and timber form factors have been used in making tables, but in European forests form factors are perhaps more regular than in our virgin timber, and cubic measure lends itself to form factor expression more easily than does the board foot.

The use of the present frustum form factor method in constructing volume tables with varying top diameters involves an exceedingly complicated base table of frustum volumes and one which is not universally applicable. To overcome this difficulty, Weitknecht has proposed that the scaled contents of the merchantable part of the tree be compared to the contents not of a frustum, but of a full cone whose height is equal to the total height of the tree. The base table will show the volumes of entire cones expressed in board feet and the factor will be a timber form factor instead of a frustum form factor. This would make it possible to estimate by total height, a procedure that I have said before has points of superiority over merchantable

height cruising. It would also make it possible to assume any intensity of utilization that is desired, *i. e.*, to have a graduated top diameter limit. It would make it necessary to have but one base table for the whole country. The intensity of the utilization would be allowed for in the form factor and could be changed to suit conditions without changing the base table or the standard of height measurement. A cylinder could be used as well as a cone for the basis of comparison and it would be easier to compute its volume in board feet.

That Bruce's method, which perhaps may revolutionize our method of volume table preparation, should have been introduced to American foresters so recently, as the result of one man's study, is striking evidence of the possibilities that lie before the investigator in the realm of forest mensuration.

A UNIVERSAL VOLUME TABLE

Foresters who have a dozen or so species of trees, for each of which a separate volume table must be used on a single cruising job, have long wished that there might be a universal volume table, *i. e.*, a table which would fit all species everywhere. Perhaps it is Utopian to even hope to get one which can be used in National Forest cruising, but yet who knows what further investigation will bring forth. The Lacey volume tables and Schenck's cruiser tables, already spoken of, are truly universal tables, but since one is based on three, and the other on four, variables, I do not believe they are usable when the individual trees are tallied by species.

Bruce has pointed out that the frustum-of-cones-base table can be used as a universal table by applying correction factors for each species. These correction factors are the frustum form factors themselves. Theoretically the frustum form factor varies for each diameter, but tests have shown that an average flat factor for all sizes can be applied with only slight chance of error. By this method the tally of each species can be worked up by the one table and then a species form factor can be applied as a correction. Some little saving of time in volume table preparation, but none in the mechanical office work of a timber survey project, can be effected by this method.

Prof. Chapman says,[3] after a discussion of the possibilities of making a universal table, "Where trees differ in form, in degree of utilization, and in standard of board foot measure applied to their

[3] Proceedings Society of American Foresters, Vol. XI, No. 2, p. 191.

contents, there can never be a universal volume table which can be applied without modification to different species." He thinks that the nearest approach that we can make to a universal table is to have a universal base table of frustums for each diameter and height class and for various top diameters, *i. e.,* for various tapers. From this base table, by systematic measurement of ten or more trees, form factors for each diameter class can be secured, with which the table for each species can be made very easily.

Braniff used, in cruising on the Crater Forest in 1911, a sort of universal table invented because of the lack of good tables for the several secondary species and to save office work. His method was to cruise and tally the trees by species, diameter and height in the usual fashion and then work up each species with the standard western yellow pine volume table. Correction factors, or form factors, were then secured from the measurement of a few trees and by comparison of existing volume tables, which showed the relation between the volume of each species and of western yellow pine for certain diameter classes. For example, white fir 14 to 24 inches in diameter might have a factor of .89, Douglas fir of 1.23 for small trees and .70 for the larger. These factors were then applied to the volumes computed by the western yellow pine or "universal" table. This method is essentially analogous to Bruce's suggestion for the use of a universal table outlined above. It saves a little in office computation, but not much. It is really only a makeshift in the absence of good tables for all species. It has great possibilities, however, if our cruising practice were somewhat modified. Braniff has proposed such a modification. I should like to speak of it briefly, though it is a detail of cruising technique rather than of volume table preparation, for if adopted it would create a demand for a very different sort of table from what we are using now. His plan[4] is for the cruisers to use a volume stick on the strip surveys (instead of a Biltmore stick, and based on the same idea), this stick to have six sides, on one of which inches is engraved and on each of the other five the volume in board feet by the universal table for each merchantable height class. The cruiser would then read from his stick direct the "universal" volume of each tree and so tally it by species. Braniff suggests, however, that the trees be tallied by diameter groups also. All that would be needed in the office is to add up the separate volume tallies and apply to the

[4] American Lumberman, February 29, 1912, p. 82.

universal table the correction factors for each species and diameter class, which are in reality the form factors. If there were good form factors available (such as those obtained by Bruce's method) it would seem to me that this method was intensely practicable and one that would make an enormous saving in office work, at some sacrifice of field work, however.

Whatever form of table is adopted, or whatever method of construction is used, it is most essential that every table should contain a full explanation of its construction. The user of the table must know how the table is made, otherwise he will not cruise to the table and will not make the proper allowance, for allowance must be made in the use of any table. There is more chance for error in the unintelligent use of the table than there is in the construction of the table itself. It is the duty of the maker of a table to have it so clear on all points which affect its value that the cruiser can use it as it was intended that it should be.

FOREST SUCCESSION IN THE CENTRAL ROCKY MOUNTAINS[1]

By Carlos G. Bates

Forest Examiner, Forest Service, Denver, Colo.

The subject of succession as a phase of ecology is the peculiar property of foresters. Not only were foresters the first to put to general and practical use the principles of ecology as a whole, but they were doubtless also the first to realize in connection with a practical and economic question that the denudation of an area bearing a certain kind of vegetation was not always followed by the return of the original vegetative type. This was brought to their attention, for instance, in the denudation of the mountains of France and of Italy, which, after remaining practically as waste lands for several decades, have finally been restocked with forests at great expense. In a lesser degree, the managed cuttings result in a natural succession, as, for instance, when a spruce-beech forest reproduces primarily in beech, with the spruce returning only after a considerable lapse of time. The European forester, with his long experience in dealing with succession, has not only learned to recognize its laws in a rough way but to control the operation of such laws by a system of management fitted to the particular case, of which the main silvicultural feature is the degree or kind of cutting to be performed.

It is because of this practical bearing of succession upon forest management that foresters feel an intense interest in the scientific development of the subject and hope to assist in such development. In giving such assistance they are likely to be out-run by grazing experts, agronomists, and other students who deal with short-lived vegetation. But even though the completion of a sere may with arboreal vegetation require a period of 100 years or more, the fact still stands that forests will present the finest examples of succession and one of the most, if not the most, fertile field for its study. Furthermore, we must recognize that under a large variety of conditions, the search for the climax formation leads one to the forest. Just how far it is true that the forest will ultimately form the climax in every sere left to its natural development, I am not prepared to say, though Clements apparently holds that this is the general rule.

---

[1] Read before the Botanical Society at Washington, D. C., February 6, 1917.

This paper is not based upon any special or detailed studies of succession, but rather upon general observation over a number of years in the mountainous territory of Colorado and Wyoming. It is not so much my purpose to describe the important forest successions in this region from the scientific, ecological standpoint as to indicate the practical importance to the forester of having in mind this conception of the systematic development of vegetation by definite stages. This is only one of thousands of examples in which scientific conceptions become of practical importance in pointing out the laws of nature, in warning against attempts by man to dodge their operation, and in showing him how they may be controlled.

In the region of which I speak there may be recognized four climax associations with which the forester is concerned. These are the *Juniperus-Pinus-hylion,* or Pinon-juniper open woodland forest; the *Pinus-hylion,* or yellow pine forest; the *Pseudotsuga-hylion,* or Douglas fir forest; the *Picea-Abies-hylion,* or subalpine spruce forest. These have been named in the order of their zonation. Clements, in his latest work on "Plant Succession," recognizes for this region only three climaxes, combining my second and third units under the name *Pinus-Pseudotsuga-hylion.* It is true that foresters similarly try to simplify the matter, but more often speak of the yellow-pine type and the "transition" or Douglas fir-pine type as separate units. I think it can be quite easily shown that the yellow pine and Douglas fir forests represent two distinct climaxes. It is, further, of practical value to distinguish them, because one frequently occurs in a region without the other; and where they occur in the same general locality it is under such widely different edaphic conditions that the distinction is more than the distinction between two consociations of the same formation.

In practical forestry the primary aim is to perpetuate the forest without the expense of planting. We are therefore concerned with secondary successions or subseres much more than with priseres. This is distinctly not the case, however, in artificial forestation work, and I regret to say that many attempts have been made to plant forests where the edaphic conditions, when carefully scrutinized, are found to indicate a stage of development far below that which would naturally bring the climax forest into existence. It is true that forest planting with nursery stock has been a success in the sandhill region of Nebraska, and even on gravel slides in the Pikes Peak region. Both of these habitats are at stages below the climax development. In both of these

cases and in many similar ones, however, the direct seeding of forest trees has been an absolute failure. The only habitats in which success has resulted from direct seeding, namely, the Douglas fir type of the Arapaho Forest and the yellow pine forest of the Black Hills, were areas from which the climax forest had been removed by fire but a few years before, and on which the soil conditions had undergone little, if any, change. So I think it should be evident that the forester, when contemplating artificial forestation, must have a clear conception of the developmental stage of the site. This is summed up in our general instructions by the very simple statement that the site proposed for reforestation work should show clear evidence of having borne a forest at some time in the not too distant past.

Now, as I have stated, the forester is primarily concerned with subseres, or short-lived successions, in which there is involved no great change from the conditions which produced the climax forest. Any one who has given this matter a moment's thought, however, knows that an almost imperceptible change in the conditions induces a new, or at least changed, society of the herbaceous layer. The grasses, herbs, and shrubs, and even some trees which we most particularly do not want, are waiting like flies on a screen door, and the moment that door is opened in they rush. In considering some of the problems which this situation presents to the forester, it will be well to take up the various climax associations separately.

We may dismiss the *Juniperus-Pinus* formation with the simple statement that, owing to its xerophilous character, this association never has the character of a true forest. The shrub and herbaceous societies within the formation are always prominent, and it is doubtful if the amount of cutting which we are likely to do in this formation, or even fires, which would injure the dominant species least of all, will materially alter the nature of the formation. Changes occur very slowly in such a formation as this, and there has not been time to determine what trend they will ordinarily take after systematic cutting.

In the yellow pine forest there is a distinct problem of succession following each fire or cutting, which creates a new subsere. Fortunately, fires rarely, and cutting never, entirely destroy the climax formation over large areas. There is, therefore, usually no question as to the availability of seed of the yellow pine. Either of these methods of partial denudation, however, may be destructive of much of the young growth of pine, and releases from shade and from competition

many plants, particularly grasses, which are always present as a distinct layer society. These quickly form an almost impenetrable sod, so that seed of pine not only finds cover with great difficulty, but is subjected to the keenest competition for moisture in a situation which is, at best, semi-arid. I will not attempt to trace in detail the struggle which ensues. Suffice it to say that lack of moisture, early frosts, and lack of winter snow, when the denudation has gone to any great extent, retard the return of the climax formation for many years. It is therefore of the utmost importance to forestry that cutting in this formation should be very conservative, and that even grass fires should be excluded with all vigilance. In some localities white fir (*A. concolor*) appears as subdominant (society) in this formation. This is rarely, however, of any great significance. Since it is favored by shade and by the moisture of stream banks, it is probable that it can be completely excluded from the reproduction by the kind of cutting which is most favorable to yellow pine.

When we turn to the Douglas fir formation we have a much more complex problem. First, let me state that this forest, being fairly dense and yet rarely too moist to permit the spread of fire, has been most deplorably ravaged. The Douglas fir forests now remaining in Colorado and Wyoming probably cover no more than 5 per cent of the area which they once occupied. In Wyoming and in Colorado as far south as the Pikes Peak region in the east and the Gunnison-Rio Grande Divide in the west, the Douglas fir formation has been so completely invaded by lodgepole pine that there is little possibility of a natural return to the climax formation within the next 500 years. In many cases one may travel for miles through this forest without seeing a vestige of the Douglas fir. Here, of course, succession must be retarded by the lack of material for migration. Again, an occasional large and thrifty seed-tree of Douglas fir will be found in the lodgepole forest, but its progeny are absolutely nonexistent. An explanation of this failure to reproduce is one of the most important questions facing us. For the most part, Douglas fir has been relegated to dry, rocky areas in which a fire could not spread and from which, it is readily seen, the fir can spread only very slowly.

It is thus plainly evident that the treatment of the lodgepole subclimax forest is a distinct problem in itself. Some of us believe that the climax formation would be so much more valuable to forestry as to justify its artificial restoration, and investigations are now being made along this line.

In the southern part of Colorado lodgepole pine has not invaded this formation. Apparently, the conditions are not suited to the pine. Perhaps also the fires have been less recurrent. At any rate, the problem is different. There occur in the remaining Douglas fir forests usually a few specimens of yellow pine, limber pine, and Engelmann spruce, and in some localities blue spruce. Aspen is almost always present as a subdominant, and after a destructive fire this broadleaf, by reason of its ability to produce root suckers, almost immediately takes possession of the ground. In the course of a few years seedlings of Douglas fir and its associates begin to appear, and these without difficulty develop under the cover of the aspen. Douglas fir will usually predominate at the completion of the sere, simply by reason of its perfect adaptation to the conditions. When this development is to occur after a heavy or complete cutting of the forest, the forester is, of course, concerned with eliminating the inferior associates as far as possible and with reducing the retarding influence of the aspen subclimax. In one case which has been quite carefully studied the following facts have been noted:

In the second year after the cutting a very good crop of all coniferous seedlings was secured. Douglas fir was in preponderance on areas where the cutting was moderate; where no cutting had been done Douglas fir and Engelmann spruce occurred in about equal numbers; where all the trees had been removed limber pine reproduction was nearly as abundant as that of Douglas fir. In this clear-cut area aspen sprouts were very numerous and vigorous, but there were very few of them in the half-cut forest. In all areas there was a larger crop of seedlings during the third than during the second season after cutting, although the latter had not been a seed year. These facts point to the following: (*a*) The seeding of a clear-cut area is evidently not, in the main, from the side. The large number of limber pine seedlings occurring in groups indicates that the seeds are either brought in by birds and cached or cached by mice or birds before the cutting was done. In view of Dr. Hoffman's findings with Douglas fir in the Northwest, I incline to the belief that much seed must be stored in the forest floor, and that it is ready to germinate within a year or two after the proper conditions have been created. (*b*) It is evident that clear cutting gives a great advantage to aspen sprouts. (*c*) The question of the elimination of inferior associates, limber pine in particular, is not solved by removing the limber pine seed trees. It may be that we shall find that

a very light cutting will cause the Douglas fir seed to germinate without allowing sufficient light and heat for the more exacting limber pine. This is a very neat problem, on which a great deal of work must be done.

Now a brief word about our Engelmann spruce. In part, its history is very similar to that of the Douglas fir formation, in that after repeated burnings the lodgepole pine subclimax succeeds, and after less severe burning the aspen. This is not true, however, of the higher or strictly subalpine zone of the spruce formation. Here in the primary succession Engelmann spruce is preceded by either a *Pinus-flexilis* or *Pinus-aristata* subclimax. Similarly, in the subsere, after severe burning, it is usually one of these two remarkably wind-resistant pines which begins the succession of trees. These come in one by one until all age classes are represented. The nature of the invasion leads me to believe that the seed, which for both trees is quite heavy, is transported mainly by jays, perhaps in part by rodents. With any of these subclimax species Engelmann spruce, because of its tolerance, can compete readily whenever the conditions necessary for the final stage of succession have been created.

In the subsere brought about by cutting an entirely different situation exists. The climax formation is typically a mixture of spruce and alpine fir, the latter varying, according to site, from an insignificant clan to an important society. So nearly the same are the requirements of the spruce and fir that there is much doubt as to whether the latter is favored by a little more moisture or will simply tolerate a little more shade, a little more soil acidity, and a little less heat. Be that as it may, we find where the fir exists at all that after a very light cutting its seedlings preponderate in the reproduction. Generally a heavier cutting seems at least to give the spruce equal chances. Because of the great value of spruce forests for protection, it is not always, however, allowable to cut as heavily as might be desired for the immediate return of the spruce. I think you will see, therefore, that here again the forester is confronted with a problem whose correct solution depends upon a detailed analysis of the factors which control the composition of the plant community. There is here little chance for the development of a subclimax formation, but there is great possibility, if the denudation in cutting does not go quite far enough, that the more valuable spruce will be replaced for a generation by the much less valuable alpine fir.

SUCCESSION AS A FACTOR IN RANGE MANAGEMENT[1]

By Arthur W. Sampson

Plant Ecologist, Forest Service

By succession is meant the establishment of plant species by a series of invasions in a given habitat causing the replacement of one set of plants by another. This alternation in the vegetative personnel is apparent when the natural conditions of the habitat have been disturbed either by physical or biotic forces.

Where the vegetative cover has been interfered with more or less seriously, as is often the case on pasture and range lands, but where subsequently these disturbances have been eliminated or decreased in intensity, there is a tendency through successive invasions, for the vegetation gradually to become more like the original. The succession continues until the equilibrium is finally established between the environment and the vegetation which it supports. This vegetative stage marks the ultimate, climax, or stable type and is quite in harmony with the world around.

In general the stability of the vegetation cover of a pasture unit and the cropping of the herbage year after year are not particularly harmonious, though this will depend largely upon the way in which the herbage is grazed. If, for instance, the leafage—the laboratory of the plant—is devoured each season at a time when the elaborated food material is needed for the proper development of the vegetation and for seed production, the effect of grazing may be reflected in various ways. Conspicuous among these are: (1) delay in the time at which growth begins in the spring, (2) decreased size and number of leaves, (3) fewer flower stalks coupled with later appearance of the stalks, (4) delayed seed maturity, limited seed production, and lowered viability of the seed crop, and (5) low germination and limited establishment of seedling plants in the following spring. Hence the stability of the type is interfered with and the invasion and succession of transitory species made possible.

In the management of the range from the standpoint of the maintenance of the forage crop, it is extremely important to have a reliable record as to the changes that are taking place in the composition of the vegetation in general, and especially the extent to which the more valuable forage species are holding their place against grazing.

---

[1] Read before the Botanical Society of Washington, D. C., February 6, 1917.

On the basis of such data it is possible to state authoritatively whether or not a change should be made in a given system of management.

The Quadrat

Regardless of the experience the ecologist has had in successional and revegetational studies, he cannot determine with precision the successional trend of vegetation subject to more or less close grazing season after season. Accordingly the quadrat method of study has been developed to furnish authentic records of the vegetative changes. Three methods of mapping or quadrating are usually employed: (1) the chart quadrat in which the exact location of each plant specimen is shown as it occurs naturally on the plot, (2) the list quadrat in which the abundance and composition of the vegetative cover are merely listed regardless of exact location, and (3) the denuded or depopulated quadrat in which the vegetation is completely removed and the subsequent invasion and succession recorded. These different kinds of quadrats have particular merits in revegetational studies and are applicable to special conditions.

Analysis of the Data

To obtain reliable data by means of the quadrat is one thing, and to analyze and crystallize the data into tangible and usable form is quite another. In range revegetational work it has been found helpful to divide the data obtained from the various quadrats in three groups: (1) those showing progressive or positive succession, (2) those upon which the succession is retrogressive or negative, and (3) those upon which the succession is problematic or indifferent. Progressive or positive succession pertains to the invasion and establishment of species having a forward march towards the climax type. Retrogressive or negative succession has to do with vegetative invasions that go back or away from, rather than towards, the ultimate type—in other words, invasions characterized by the establishment of transitory and possibly more primitive species, such as characteristically occupy newly formed and depleted soils. Problematic or indifferent successions pertains to vegetation whose successional trend cannot be declared either as positive or negative, but merely marking time as it were.

From revegetation studies conducted by various investigators it is now well known that certain species inhabit newly formed, depleted, and sterile soils while quite different species predominate on the older and richer soil types. During the past season several cultivated and

native species of plants were grown in soil subject to more or less serious erosion and leaching and in soil of the same origin and type but not exposed to erosion, and consequently much richer in organic matter and certain soluble salts. In the case of Canadian field peas grown in the eroded soil 841 pounds of water was required for the production of one pound of dry matter, while in the non-eroded soil only 467 pounds of water, or only .555 as much was required. Other species gave similar figures. Corresponding contrasts in the vegetative development of the plants were also observed.

This experiment, among other highly important economic facts, shows that succession is doubtless retarded on soils subject to erosion and to other conditions tending to deplete the soil.

Application of Successional Studies

The practical application of successional studies to the establishment and maintenance of a definite vegetative type will be determined chiefly on the basis of the knowledge one has of the successional stages represented by the different species coupled with their growth requirements. Let us assume, for example, that on badly eroded or denuded range we desire to reestablish the climax species and the weedy annuals of little or no forage value are the primitive invaders, and that these are followed by the establishment of shallow rooted, rapidly growing, and early maturing biennial and perennial plants. As these vegetational cycles progress and enrich the soil with humus, thereby changing the physical structure, total water-holding capacity, and the wilting coefficient of the substratum, they pave the way for the more exacting deep-rooted perennials which predominate in the climax type. If the successional stages of the conspicuous species are known and their increment from year to year determined, one may be in position to declare definitely whether or not the particular method used of harvesting the crop will, within a minimum period of time, promote maximum positive succession. If it is known that certain temporary vegetative cycles must precede the invasion and establishment of the species desired in this instance it would, of course, be extremely unwise to alter the particular management which has been responsible for the development of these cycles. The climax stage of persistent deep-rooted perennials would naturally invade slowly at first but their appearance would be evidence of the fact that the management under operation was conducive to the invasion and establishment of the species desired and, therefore, there should be no change in the man-

agement even though undesirable species predominated for the time being.

The foregoing statement refers to progressive or positive succession. In the case of a range of maximum cover of desirable forage species it would, of course, be preferred to interfere as little as possible, consistent with maximum utilization, with the existing type of vegetation. However, should the use of the range be such as to break up the stability of the climax cover, retrogressive or negative succession would show itself, the rapidity and magnitude of which would depend upon the extent to which the growth requirement of the vegetation was interfered with. The element of instability of the permanent type would become apparent, first by the disappearance of the most palatable species, and later by the invasion of early maturing transitory species.

In the event that the range is properly provided with quadrats or sample plots and the normal density and composition of the vegetative cover known, one would be provided with data which would show clearly the extent of progressive or retrogressive succession, whichever the case might be, and the rate of improvement or depreciation.

Knowledge of the successional trend of the vegetation is well nigh indispensable to the working out of a judicious system of management. Thus the management of grazing lands, like that of woodlands, is gradually being placed upon a scientific basis in which applied ecology, and particularly succession, plays a prominent and highly important part.

NATIONAL FOREST FINANCES

By T. S. Woolsey, Jr., M. F.
New Haven, Conn.

The management of National or State Forests can be based upon a broader financial policy than that of private forests. The private owner is usually intent upon the best money returns per dollar invested, or upon some other special personal advantage. He may care nothing for his forest from the standpoint of permanent production. Nor is he willing to make any outlay for seed trees to secure natural regeneration, or for planting or sowing, if propagation must be artificial. His aim, too often, is to wreck the timber capital as rapidly as possible so as to reinvest his money, regardless of the impoverishment of the soil. Usually he finds the denuded land has a sale value for grazing purposes, or for temporary or permanent agriculture. He cares nothing about the evident influence of his forest in protecting the soil, the water resources, or furnishing a place for recreation. The farmer or estate owner may manage his forest from the standpoint of future production simply because the woodlet or the forest is part of his farm or country place. Under these conditions the money returns are not so vital because the land will be retained in forest even if the forest pays but 3 per cent on the capital invested—represented by the land, timber value, crop, tax and annual administrative expenses. Fernow has rightly emphasized the comparatively small rate of interest which forestry for future production pays, notwithstanding the ever increasing value of land. He has shown (in his Economics of Forestry) that German forests pay but 3 per cent on a conservative capitalization. But in addition to this direct income the capital value of the land (in Saxon forests) increased from $100 to $150 per acre in a period of but 50 years, thus bringing up the net earnings to 4 per cent. Nevertheless, it is apparent that forestry for production can only be permanently practiced by the public, by corporations, or by the exceptional private owner, perhaps as an adjunct to another business. Many of the noble families of France have disposed of their forests because they could not afford this form of investment. A return of 3 to 4 per cent was not enough. A member of the Bulgarian Royal family not long ago sold the forest of Amboise to a member of the Service des Eaux et Forêts of France. The new owner (Monsieur

Hirsch) expects to net 4 per cent on his investment, but anticipates that part of his remuneration will be "in the enjoyment of improving an impoverished stand by scientific technique." Monsieur Hirsch is the exceptional private owner and must be something of an idealist. The duc de Penthiève (of the Orleans family) insisted that forest management should not interfere with the shooting on his domains at Arc-En-Barrois. According to the local forest officer this penalized the financial returns because of resulting damage by game to young stands under regeneration. The investment netted about 2½ per cent. When the private owner is permanently practicing forest production he must have other benefits to eke out the money returns. Otherwise his forest is usually not a paying investment (judged by current rates), unless there is an unusual speculative value added by increases in stumpage values. How often does the forester invest his own money in a forest property with the sole aim of a profitable investment? There will be an increasing area under public ownership—this is right and logical.

With public forests the viewpoint is somewhat altered. Financial returns count, to be sure, but frequently the chief aim is protection of the soil and water resources, or enjoyment for the public. But it is dangerous to ignore returns altogether. There are forests in the Alps and Pyrenees that are purely protective zones against erosion and avalanches. They are frankly managed with this in view. The forest of Fontainbleau, near Paris, is managed for enjoyment and the veteran trees are preserved for artistic reasons when it must be evident they have passed their maximum mean annual growth and are decreasing in quality. But even such forests yield net returns under European markets. Who would suggest that the Angeles or Cleveland Forests in southern California, near San Bernardino and San Diego, be abandoned simply because they showed no net dollar returns? Their watershed value, let alone recreation, more than justifies the annual net deficit of about $0.03 per acre. Our western market conditions are poor compared with Europe. In public forests the indirect returns may be more important for the future of a locality than the direct returns in money. Yet is it not unquestionably a dangerous policy to neglect legitimate income that *can* be secured with proper rates on natural resources? Should income be neglected entirely even on National Parks? The public forests of every one of the great Powers yield handsome net returns.

Fernow tells us in his Economics of Forestry that Saxon forests netted $1.63 per acre per year in 1850, $2.45 in 1870, and $5.17 in

1890; Prussia's forests netted $0.46, $0.87, and $1.30 at these dates. In France the net returns in 1897 were $1.05 per acre per year. Even Russia in 1896 netted $0.02 per acre in 1896 and Italy $0.33 in 1893. During the period 1865-1867 British Indian forests returned $460,000, and in the period 1892 to 1897 $2,580,000 per year above expenses. In the Philippines the net revenue for the period 1901-1915 was 57.3 per cent of the gross. *With our National Forests the gross revenue has been about half the cost.*

Before assuming too critical viewpoint on this poor showing it is essential to look at the results of the public lands policy in the past. Such a background will give a surer perspective. Before conservation was recognized as a national policy was the disposal of natural resources a success? The answer is decidedly no! The history of the disposal of our public lands shows unreservedly that the speculation and waste attending the disposal of our western resources dulled the public conscience to such an extent that theft and speculation were accepted as the necessary accompaniment of successful land acquirement; there was no other practical way the speculator argued. Such a background of misuse makes commercial charges for a privilege (such as grazing) all the harder for the West to bear. And let us not lose sight of the fact that the greatest single contribution of the Forest Service to the West has been its success in raising the standards of western land administration. Think of the difference between the standards on the public domain in the eighties and those evidenced today by the usual minute and accurate appraisal of public stumpage. But a proper balance in financial policy has not yet been reached. Judging from the last Annual Report of the Forester, the Service itself is not satisfied with present grazing fees; it is understood that they are to be increased 25 per cent. This is a step in the right direction. But the public should not overlook the fact that in the case of grazing fees (increased even 25 per cent), private companies and others through the present partial valuation of grazing rights, are still profiting in the use of National Forest range at the expense of the public. Suppose timber were sold at half its value would the public be satisfied? The longer the Department of Agriculture waits before putting the range resources on a fair financial basis the harder it will be to make the needed increases in fees later on. The present increase *without* provision for the future is not encouraging.

According to H. H. Chapman: "Special subsidies or privileges of considerable financial value must not be given any individual (or

corporation for purely business advantage. If this is done . . . it means that the bargain is one-sided, and, therefore, the other party (the collective owner or public) loses." This is sound policy to steer by, and does it not cover the present situation?

Rather an interesting analysis of Forest Service charges can be made by classifying the products disposed of according to whether 1—Free, 2—Partial Payment, or 3—Full Payment.

1. Free

Kind of Resource	*Analysis of Gift*
Water power	Free to municipal corporations; if less then 100 h.p. is developed; if developed in connection with another sale; if developed as an auxiliary to irrigation.
Special uses	Free for a large number of uses where they benefit the forest, or are of a public character, temporary, connected with an industry already paying fees, where there is cooperation for the benefit of the public, or if noncommercial.
Timber	If the timber is used for the United States needs, if for the protection, improvement, or investigation of the forests, or for the personal use by settlers, residents, and prospectors.
Minerals	Free, although commercial in character, because of the need of developing the West, and because of the difficulty of discovery. Curiously enough this free use seemed illogical to a professor of economics, who considered the problem.
Grazing	Free to prospectors, campers, travelers; to timber sale purchasers for use of logging teams; to settlers in or near National Forests (up to 10 head); to Indians, enrolled upon the records of the Office of Indian Affairs dependent upon the National Forest range.
Summary of free use	The main reasons for free use appear to be justified on the grounds of helping the small man, benefiting the forests or the national Government, to avoid a duplicate charge, to facilitate transient or temporary use of the forests, for Indians (with prior claims to the resource), for cities, to encourage the discovery of minerals, and to benefit agriculture. Why cities should have free power is not entirely clear. A State cannot have the free use of timber!

2. Partial Payment

Kind of Resource	*Analysis of Partial Rates*
Water power	The commercial rates are probably less than could be charged, but this is a matter of controversy.
Special uses	The rates are below the full commercial charge for no clear-cut reason.
Timber	Sales (at the cost of administration) of dead and down timber (to improve the forest), for the benefit of *farmers* to help agriculture. Timber, which is a menace to the forest, may be sold below the face value, though used for commercial purposes.
Grazing	Present fees are undoubtedly one-half to one-third the commercial rates for similar privileges on private land or on neighboring Indian Reservations. No apparent justification. Probably an outgrowth of the former free use of the public land for grazing purposes.

Summary.......... If the use is of a commercial character and does not benefit the forest, a small settler who uses the land (in accordance with free use policy) or agriculture (evidently a preferred occupation) then partial rates do not appear to be justified.

3. Full Payment

Kind of Resource	*Analysis of Full Payment*
Timber............	The charges for this resource, if for commercial use, are already based upon the full appraised value, *a policy which originated with Congress.*

The foregoing synopsis was prepared for an eminent authority on economics, in order to give him an idea of the present Government policy. His name has been purposely withheld but his review which follows is of wide interest to the profession:

"In general, I should say that it is a sound principle for a service belonging to the nation to charge full rate, except where a different policy would clearly and definitely be to the advantage of the nation. This would imply that, in general, full commercial rates should be charged for undertakings where the chief object is profit.

"There is evidently involved in the minds of those who have developed the policies which you detail, another consideration, namely, the encouragement of the small man. This may well be brought under the general principle of national advantage, as it is distinctly against public policy to encourage inequality in wealth. Nevertheless this subsidiary principle of helping the poor is one, the limits of which, I should imagine, would be extremely difficult to confine. It ought, therefore, to be used, I should say, cautiously and only in extreme cases. It is true that even in private life a surgeon will charge lower rates to the poor, and free dispensaries are provided by organizations and cities for the poor. Sometimes the poor are favored in respect to the price of necessities, such as milk, bread, or coal. But outside of such fields as those mentioned the principle of one price for all still holds. By stretching terms, we may perhaps say that the charge which the Government makes, called taxes, is definitely adjusted according to the means of the citizen. If this principle were extended universally, the inequalities of wealth would be theoretically effaced completely, everyone being charged the price befitting his income, whatever be the commodity or service charged for.

"This would be the ideal of socialism and a socialist might say that the only reason that we are all charged in general the same price for, say a yard of cloth, is that, in an individualistic society, supply and demand prevent discrimination in favor of the poor. In other words, it might be said, that the one-price-for-all system obtains in general, not because it is right, but because it cannot be helped. The rich man who found himself charged a higher price per yard for cloth than the poor man would claim poverty, or make his purchases

through the poor; and this sort of evasion always occurs, as you of course know, wherever anything other than a one price system is tried.

"I should say that, avoiding any doctrinaire socialism and applying the rough rule of common-sense ideas which express the sanest public opinion, if I were a Czar to decide on the various points you mention, my decision would be something like the following: I would approve, I think, of full payment for timber in accordance with the present practice. I would ask full payment for grazing also and for special uses or rentals, as well as for water power. Exceptions, where practical, might be made in all these matters for new settlers of small means and timber could be, as is the practice, sold at cost to such persons when dead or down if it is a convenience or a public service to get rid of this any way. Also where necessary to improve or protect the forest, timber could be sold for less than its full value, as in the case of the example you mention after a fire. Free use in specified cases might be offered to help the small settler or for public use, or for protection or improvement of the forest or in connection with another enterprise already being paid for to obviate a double charge, or for temporary or transient use, or for Indians who used to own the land of the West.

"I think I should charge full rate for water power, *even to municipal corporations, possibly making an exception for projects that develop a small number of horse power, in order to help the small owner.* I see no objection to making water power free in connection with timber sales and, as an auxiliary to irrigation, although I am not sure that I understand these items. I should think timber should be free for the telephone lines which protect and improve the forest and possibly to new settlers for personal use and domestic purposes where the settlers are of moderate means, also for the use of another department, or for protection, improvement, or investigation of National Forests.

"I do not see why mining should be free everywhere. I should think that grazing might well be free to prospectors, campers, and travelers to encourage prospecting and traveling, from which good public consequences are likely to ensue in the way of settlement, development, etc. I should think that grazing might be free in connection with other paid enterprises, as for example, logging teams in timber sales to avoid double charges. I should think there was good sense also in having it free to settlers in, or near the National Forest, up to a certain limit in order to favor the home builder. It ought also, for reasons of national good faith, I assume, be free to Indians enrolled upon the records of the Office of Indian Affairs, who are dependent on the National Forests. I should think that under rentals or special use, telephone and telegraph lines should be free in exchange for the free use by forest offices, or free use of the poles for stringing Forest Service wires to telephone lines. Also rentals should be

free for uses where the use benefits the forest, or is of public character, or connected with a paid industry, or where the use is cooperative.

"I have tried to answer your letter in detail by a simple arbitrary pronouncement on the items, as I do not know how best to express any answer in general terms. Needless to say, I do not feel that such a pronouncement is in the least authoritative. I suppose there is no more difficult field than the one of practical economic ethics."

Does not this analysis of the more important policies governing the disposal of natural resources drive home the necessity for full appraised charges for commercial grazing? The main reason why the Department of Agriculture does not act more aggressively seems to be because of the political power of the western grazing organizations. The Forest Service as a whole is clearly in favor of further increases; but will it succeed in getting them? The result of the fight for full commercial rates will be regarded with interest by the friends of forestry in the United States, *because this is the fairest and easiest way to make the National Forest self-sustaining.*

It cannot be denied that a sincere fight for *commercial rates for commercial grazing* is not without its risk. For example, if the right to graze went to the highest bidder, *without restriction,* the small man might be crowded to the wall. For this reason suitable protection should be accorded Class A permittees (small resident owners). This is entirely feasible. It is fundamental to the wise use of the western National Forests that nothing be done to restrict the settlement of land chiefly valuable for agriculture. Even commercialized *dollar grazing* cannot be allowed to interfere with the homestead—the "soul of the West." With higher rates, the permittees may naturally expect more range development at the expense of the Government. There can be no objection to this; in fact, the costly development of water and fencing by the live-stock company will in the end prove embarrassing. But even more intensive fencing can undoubtedly be arranged without detriment to the settler with the efficient price generally at the disposal of the Forester. The details can be thought out.

When well-entrenched special privileges—such as the grazing industry on National Forests, which those on the inside must know is in many localities in the control of a few men—must make an organized fight against higher rates, what will be their line of campaign? Who can say? One method of defense is by attack. That we have learned from the Prussians! Probably one measure will be to show that there

has been an unprogressive Forest Service grazing administration, and that therefore the Forests should be turned over to the States, something that would prove fatal to western conservation in its best sense. Such a move would have the advantage of perhaps driving the Forest Service to cover. Luke-warm adherents of higher grazing fees might say: "See what you have done by your campaign for commercial fees; you have started something which may in the end hurt us. Let's drop the whole thing." The only answer is: "It's a square and business-like move, and in the end higher rates must come. We'll fight attacks and win out on the merits of the question."

Then there is the plea of cheaper meat with low rates, and so on *ad libitum*. There will be no lack of arguments. The move for much higher rates is economically sound; the war will add force to the arguments of ordinary times. Grazing should bear its share of higher taxation along with other industries. That such an increase is not feasible without injury to the small-man policy, so firmly established, is, as the Englishman would say, "beastly rot."

THE COST OF TRANSPORTATION AS A TAX ON THE LUMBER CONSUMER OF THE LAKE STATES

By K. J. Braden

The growing scarcity of stumpage in the United States is emphasized by the steady increase in mill prices of lumber from 1900 to 1908. The average mill price of thirty species in 1900, $11.13 per thousand feet, had increased by 1908 to $15.37 per thousand feet, an advance of 38 per cent in eight years. Several of the species follow, with the percentage of increase: White pine, 43.2; oak, 54.1; cedar, 65.3; western white pine, 54.9; walnut, 16.0; yellow poplar, 80.3; spruce, 44.2.

Taken as a whole, this advance in price is significant of one thing especially, namely, that the increasing use of wood substitutes cannot be expected to effectually halt the advance in wood prices, although it cannot be doubted that the increase would be greater in the absence of such substitutes. This principle is further supported by the fact that in Germany, where the use of wood substitutes is developed to its fullest extent, and where the per capita consumption of wood is only a fraction of what it is in this country, the average unit value of all wood sold from the state forests increased 47 per cent between 1898 and 1908.

Analyzing the list of increases given above, we find evidence of the competition between species. Yellow poplar and cedar, both of which have special uses for which it is difficult to substitute another species, have suffered the greatest advance in price. Walnut, which had already reached a very high price in 1900, is evidently subject to the competition of cheaper woods. The comparatively small advance in white pine must be ascribed to its sale in competition with western and southern pines, rather than to any large amount available.

This presence of western and southern species in the market throughout the Lake States is conclusive evidence of a scarcity of white pine stumpage. Twenty-five years ago the white pine controlled the market in the north central tier of states, and the price was dependent on its cost of production and distribution. As the supply decreased the value of the stumpage went up, until the southern pines were able to replace it to a large extent. As yellow pine becomes less

available, the western species are gradually taking its place. Except for special use as construction timbers, the competing species are no better suited to the purpose for which used than the native white pine. But on account of the large available supplies, they tend to set a value for white pine and to limit the advance in its price. It is evident that a growing scarcity of white pine will not raise its price in proportion, but will result instead in an increased demand for all competing species. Eventually this process of competition, if allowed to exercise full control, will make the people of the Lake States entirely dependent upon southern and western forests for their supply, and will mask the great necessity of developing a local supply on our extensive nonagricultural lands.

A perpetual supply of timber at a reasonable priçe is much to be desired from an industrial and economic standpoint. The presence of such a supply would render unnecessary the planting and care of thousands of acres of forest in the Lake States. But have we such a supply? W. B. Greeley estimates that the southern pineries in thirty years will be unable to supply more than a local demand. The western forests are being thrown upon the market, often at a loss, because of exorbitant taxes and the necessity of paying a high rate of interest on borrowed money. All the evidence leads to the conclusion that our supply of timber is going to be merely temporary, and that the price will eventually reach the cost of production under a system of forestry practice. When such a time comes, production on Minnesota land in the Lake States will be just as cheap as production on western land.

But suppose that we are assured a supply of western timber adequate for all of the needs of the State for fifty years. Is entire dependence on that supply economically advantageous? In this connection the great importance of the transportation charges paid is generally overlooked. Following are the average rates per thousand feet to Minneapolis from the different producing regions: Southern pine, \$8; Douglas fir, \$11.25; western pine, \$8.75; Idaho white pine, \$8; northern pine, \$1.40.

It is evident from the above list that every thousand feet of western and southern pine received at Minneapolis costs the consumer more in freight charges than the same amount would if shipped from the northern pine producing region. This excess may well be regarded as a premium paid to the railroads for the privilege of using certain kinds of lumber which are in most cases no better suited to the purpose

than the white pine. For the different species, the premium per thousand feet is: Southern pine, $6.60; Douglas fir, $9.85; western pine, $7.35; Idaho white pine, $6.60.

This is a burden which the people must bear indefinitely, or until an adequate supply of timber can be produced every year from local forest land. Since it is such a heavy burden, and so definite in duration, it may be considered as a tax, paid to the railroads, for the privilege of letting forest land lie idle and unproductive.

This tax, based on an annual per capita consumption of 375 board feet, and an average freight rate of $9 per thousand feet on all lumber shipped into the State of Minnesota, is arrived at in the following manner: Rate on 375 feet western and southern lumber, $2.40; rate on the same amount of northern white pine, 37 cents; tax for using foreign lumber, $2.03 per capita. For the whole State this would amount to $4,561,410, or the equivalent of a tax of 2.8 mills on all the real and personal property in the State (1915 assessed value $1,609,-493,000.) As this amount is paid by railroads largely as wages and dividends to non-residents, it is not returned to Minnesota either directly or indirectly. This tax would not remain constant, but would tend to increase on account of the following factors:

1. As the local supply grows smaller, it will be necessary to import into the State a greater proportion of rough lumber, which weighs more per thousand feet, and consequently pays a higher rate.

2. As supplies decrease in the south and the inland empire, a greater proportion must be shipped from the extreme northwest with a resulting higher rate.

3. Owing to the demands of labor and increased operating expenses, the railroads may eventually be forced to raise their rates.

To sum up the steps of this argument—

1. Local supplies of timber are rapidly diminishing in most parts of the country, with the result that a growing proportion of the demand is being satisfied by the large reservoirs of stumpage in the south and the west.

2. This growing demand upon the remaining timber will exhaust the supply more rapidly than is indicated by comparing the stumpage supply and annual growth with the present annual cut.

3. When each lumber region is able to supply only its local needs, the price of lumber will be governed by the cost of production; or if none is produced, it will be a monopoly price set by a few large timber

owners. The use of wood substitutes will be ineffectual in lowering the price of lumber.

4. If the Minnesota forest lands are made to produce an adequate supply for the people of the State, the freight charge will average $1.40 per thousand feet to Minneapolis. If lumber must be shipped from the west, the rate will average $9 per thousand feet, or more. The difference in rates will be $7.60 per thousand feet.

5. With a per capita consumption of 375 board feet, this would amount to $2.03 per capita for the whole State, or $10.15 per family of five. To produce this amount of taxation would require a tax levy of 2.8 mills per year, on all the real and personal property in the State.

6. It would appear reasonable to levy in Minnesota a State general property tax of 2.8 mills each year for forestry purposes, if such an expenditure were necessary to insure the State against entire dependence on western timber and to make the local supply entirely adequate.

A STUDY OF REFORESTED CHESTNUT CUT-OVER LAND

By E. C. M. Richards

On page 204 of Vol. XII, No. 2, 1914, of the Forestry Quarterly the results of a study of the problem of reforesting chestnut cut-over lands were discussed in an article based upon field studies made in northern New Jersey. Another article on the same subject by Professor James W. Toumey was published on page 38 of Vol. IX, No. 1, 1914, of the Proceedings of the Society of American Foresters, based upon studies made in southern New England.

In both articles one of the recommendations was that pine be planted on the cut-over areas and that ultimately the type be changed into pure pine or pine and hardwoods mixed. Both authors agreed that it would be necessary later, to cut back hardwood growth in order to prevent the pine from being overtopped by it, but there was a difference of opinion as to the effect of chestnut sprout growth upon the pine. In the first article, the conclusions reached were that the chestnut blight would kill the sprouts and that therefore no work was needed in freeing the pine from them, as the effect of a few years shade, while the sprouts were dying, would not greatly interfere with the development of the pine. Professor Toumey, however, made no distinction between the chestnut and hardwood growth as regards the need of its being cut back.

These two articles appeared over two years ago and work had been done in accordance with their recommendations at that time. Believing that the results obtained after two years' experience would be of value to the profession, a new study was made on three holdings in New Jersey and on the lands of the New Haven Water Company and the lands of the Hartford Water Company in Connecticut. The chief questions of importance considered in connection with the results of these examinations are:

(1) Will the pine establish itself readily on cut-over land?

(2) What is the effect of the chestnut sprouts on the pine, if no cleanings are made?

(3) If cleanings are necessary, how many of them are needed and how often are they required?

(4) What effect has the chestnut blight upon the chestnut sprouts?

In answering these questions each plantation is taken up separately and finally a general conclusion is drawn.

Case I.—This area is located on an upland with a 2 per cent slope towards the north, near Chester, New Jersey. The site is quality I and the soil conditions are excellent for forest growth. The stand of mixed hardwoods was clear-cut in 1911 or 1912. In the spring of 1913 three-year-old transplants of white and Scotch pine were planted among the stumps, but no special system of spacing the plants was used. Chestnut made up about 40 per cent of the original stand and the chestnut sprouts now are very vigorous, up to 2 inches in diameter and 15 feet high, exceeding the other sprouts by several feet in height, although of about the same size in diameter. The underbrush is heavy and the ground cover dense. In spots the ground is covered with dense sod. Under these general conditions approximately 80 per cent of the plantation was alive, the Scotch pine averaging 2 feet 6 inches and the white pine 1 foot 6 inches in height. The growth of the plantation was exceptionally fine, *especially wherever the trees had direct sunlight and were not over-topped by neighboring sprouts.* What caused the failures which were found, was, in nearly every case, heavy shade. The growth in parts of the plantation was badly checked by shading and through the whipping of the tender leaders by the surrounding sprout growth. The planted stock had taken hold very well but the need of cleaning was apparent in many places. The chestnut sprouts were infected with the blight and ultimately will die, but they will take several years in doing so, and meanwhile the plantation is being seriously interfered with by them. Unless severe careful cleanings are made promptly, great falling off in growth in the plantation will result.

There was a small amount of sapling growth left from the original stand which in some cases is very seriously retarding the growth of pine directly beneath it, and also injuring the pine near by. These saplings should be cut out without delay, if the pine is to be saved.

Case II.—This tract is located near Bernardsville, New Jersey, on top of "Mine Mount." Although the soil and rock conditions were very similar to those in Case I, there was more rock, the site here being quality II, and the sun and exposure to winds made it more difficult to secure a good stand of young pine. The original stand had been cut clear about 18 months before the planting was done, and a dense growth of briars, grass, and weeds had taken possession of the soil. A few trees left standing towards the northwestern part of the area will develop into "wolf trees" and should be cut. There was a dense undergrowth in spots, composed chiefly of wild cherry, dogwood, and

red maple. The chestnut sprouts were in only fair condition. They were about 5 feet high and ½ inch in diameter at the maximum. About 50 per cent of the present stand is chestnut sprout growth, but the density of the whole stand is not over 75 per cent. None of the chestnut sprouts are infected with the blight, but the prevalence of the disease on all sides of the area makes it practically impossible to secure a mature stand of chestnut. The other growth was made up of about 95 per cent sprouts of which about 60 per cent was oak. The effect of the chestnut and other sprouts upon the pine was very bad and cleanings were much needed. But in this case the chief reason for the failure of the plantation—not over 40 per cent of the trees planted now survive—is the exceedingly adverse conditions found on this site. Where three-year transplants of red pine were used they have survived and are growing well, but for the most part are being interfered with by the undergrowth and sprouts. It is evident from the pine that has taken hold, however, that even on this adverse site, pine will occupy the cut-over land very well, with the help of a few cleanings.

Case III.—In the fall of 1911, the chestnut and some of the hardwood on this area was cut out, leaving a considerable amount—about 40 per cent of the original stand—scattered over the land. Located as it is on the summit of a very rocky hilltop about five miles from Bernardsville, New Jersey, the condition of the site for planting three-year transplants of red pine was very poor indeed after a three-year's growth had given the sprouts, grass, weeds, and underbrush a good start. Add to this the fact that it is site III, exposure to the sun and wind, and finally that the planting was not done until very late in the spring of 1914, it can be easily seen that the chances for really good results were very poor. At the time the examination was made, June, 1916, only about 25 per cent of the pine was alive. The hardwood sprouts were very numerous and vigorous, being about 10 feet high and 1¼ inches in diameter. These together with the overwood cast a heavy shade and the chance for the proper development of the pine was slight. In spots this shade was very heavy, barely allowing the young pine to stay alive aside from making any satisfactory growth. The chestnut sprouts were in surprisingly good condition, considering the infection of the whole neighborhood by the blight. Some even reached 18 feet in height and 3 inches in diameter. In comparison with such growth the pine, which averaged about 8 inches in height although planted two years ago, were scarcely noticeable at

all. But the whole chestnut growth is doomed and it is only a matter of time when it will all be dead. Meanwhile however it is seriously injuring the pine.

In this case the owner has two practices to choose from. The splendid growth of the hardwood sprouts, much of which is oak, during the last two years makes it plain that there is a good chance of securing an excellent stand from this growth. Or the original policy of altering the type into pine may be followed, the area being replanted as necessary and severe cleanings made to expose the pine to the light. From the developments of the past two years, however, it seems to be more advantageous to reconstruct the plan of management and adopt the first of the above measures. The area should not have been underplanted.

Case IV.—This area was located just beyond the western outskirts of New Haven, Connecticut. There was a good deal of rock present in the soil, and outcrops of rock were frequent. Humus was present in good quantity and altogether the site may be classed as II. The topography was quite irregular in a small way, being largely alternate rocky ridges and small hollows. The area under consideration was on a gentle slope—about 3 per cent—toward the west.

The original forest on this area was nearly 45 per cent chestnut, while oak was about 40 per cent, leaving 15 per cent for ash, hickory, and other species. The stand was cut clear when 45 years old and a few trees left standing to furnish a small amount of large material at the end of the pine rotation. These overholders are "going back" and should have been cut when the original logging took place.

Directly after the cutting had been completed, eleven years ago, two-year-old seedlings of white pine were planted among the stumps, spacing as nearly 6 by 6 feet as conditions permitted. The stock was in good condition, grown in the Yale Forest School nursery, and so was very well suited to planting near New Haven. Students, using the mattock and hole method, did the work of setting out the trees. At the time of examination 98 per cent of the stand was alive and very evenly distributed. The trees had grown very well being of an average height of about 10 feet. What few failures occurred were due to shading by sprout growth. The plants have taken hold very well, but many of them are badly held back by the hardwood growth, especially those trees near chestnut sprouts. In this latter case they are so badly suppressed that the death of the chestnut sprouts, which have been largely killed by the blight, has left openings in the young

stand. The shaded trees are alive but are very badly stunted. Cleanings should have removed the chestnut sprouts several years ago.

It is of value here to speak of the effect of the blight upon the chestnut sprouts. Most of the sprouts over 2 inches in diameter were badly infected or dead, although now and then one 3 inches in diameter and 18 feet high was found in growing condition. There was apparently little or no chance for a mature stand of chestnut.

The reproduction of oak, hickory, ash, and other species, however, gave abundant evidence of being able to mature into a good stand. And right here an interesting and valuable fact introduces itself. Not only in Case IV, but on the other tracts also, it was borne in upon the investigator that the percentage of pine in the stand was largely in the control of the forester. By using his axe to a greater or less degree he should be able to secure the exact percentage he desires.

As in the first three cases the effect of the hardwood reproduction on the pine was harmful and the facts pointed to the absolute necessity of cleaning in order to bring the pine through. Once the pine attained a height of about 10 feet, and had its head above the surrounding hardwood growth—even if only for 6 inches or so—it seemed to be able to hold its own.

Case V.—This is composed of a number of widely scattered areas on the holdings of the Hartford Water Company, Hartford, Conn. The climatic, soil, and rock conditions and the composition of the original hardwood stand in this neighborhood varied scarcely at all from the conditions found in the area mentioned in Case IV. Three facts concerning the plantations here were of special interest:

(1) The very evident success in establishing young pine on freshly cut-over land under an overwood of considerable density. To establish the plantation appears to be a task of little difficulty.

(2) The short time in which the need for liberating the pine from the sprouts occurs. On areas planted directly after the logging had been completed, a cleaning was found necessary within two or three years. In this connection it seems best to clean early, for by so doing much labor will be saved because the young sprouts are handled more easily than after having reached a larger size.

(3) The splendid growth made by the European larch and the red pine. Of course all of the plantations are still young, but so far, at least, it is fair to state that both of these species equaled and sometimes exceeded the growth which might be expected from white pine.

Summing up the whole situation as far as the region including the

five areas examined is concerned, it is of interest to note the uniformity of the answers to our four questions.

Question 1.—Will the pine establish itself readily on cut-over land? Cases 1, 4, and 5 give us a decided affirmative, cases 2 and 3 give even stronger assent, because here the conditions of site were bad to begin with, and yet a certain amount of success was attained. Taking all the cases together, it may be said that pine can be established easily and quickly on cut-over land.

Question 2.—What is the effect of the chestnut sprouts on the pine if no cleanings are made? In all of the five cases the effect was injurious.

Question 3.—If cleanings are necessary how many of them are needed and how often are they required? The five cases varied somewhat in this matter, but in general there should be a cleaning not later than three years after planting, and this should be followed every three to five years until the pine had attained a height of 12 to 15 feet and has grown a foot or so above the neighboring hardwoods. In this connection it was evident that the final per cent of pine in the mature stand was largely in the hands of the forester.

Question 4.—What effect has the chestnut blight upon the chestnut sprouts? From the data obtained, it can be stated that the blight ultimately will kill the whole crop of chestnut sprouts but the process is much slower than was first imagined, sprouts having been often found which had reached over 2½ inches in diameter and 15 to 18 feet in height before succumbing. The damage which such sprouts inflict upon the pine is very severe, providing that the cleanings were necessary to free the pine from the chestnut, as well as from the other hardwood sprouts.

VOLUME OF WESTERN YELLOW PINE LOGS FROM AN ACTUAL MILL TALLY

By Swift Berry

Forest Examiner, Forest Service

In order to estimate the quality of standing timber, with any degree of accuracy, a knowledge is necessary of the contents of logs of various diameters and different qualities as evidenced by external appearance. This knowledge can only be obtained by actual mill tallies of the amounts and grades of lumber sawed from representative logs. Mill tallies of this character have been made in District 5 for sugar pine, yellow pine, Douglas fir, white fir, and incense cedar. Their character may be shown by a description of one made in western yellow and Jeffrey pine at a single-band sawmill on the east side of the Plumas National Forest.

In making this study the method followed was that usually described as extensive rather than intensive. No measurements were taken in the woods and all field work was concentrated at the sawmill, where the first step was the scaling and grading of the logs as they arrived at the mill deck. There the scaling was done by the Decimal C Rule and in accordance with the usual scaling practice of the Forest Service, exactly as if for a timber sale. Both sound and defective logs were included in the study, but culls were left out. In addition, each log was carefully classified by the scaler as being grade one, two, or three. This classification was based upon the scalers's judgment, governed by the external appearance of the log. The three log grades employed really represented clear, shop, and common (or rough) logs, the division being fundamentally upon the principal grades of lumber produced from each. Thus, No. 1 logs were those primarily cutting clear lumber. The specifications employed in this work for these three log grades are as follows:

No. 1. Clear logs shall be 22 inches or over in diameter inside the bark at the small end and not less than 12 feet long. They shall be reasonably straight grained, practically surface clear, and of a character capable in the judgment of the scaler of cutting not less than 25 per cent of their scaled contents into clear lumber, of the grades of Australian, or C select, and better.

No. 2. Shop logs shall be 18 inches or over in diameter inside the bark at the small end, not less than 8 feet long, and which in the judgment of the scaler are capable of cutting not less than 30 per

cent of their scaled contents into lumber of the grades of No. 2 shop, and better.

No. 3. Common (or rough) logs shall be 6 inches or over in diameter inside the bark at the small end, and not less than 8 feet long, having defects which in the judgment of the scaler prevent their classification into either of the other two grades.

Each log was numbered by the scaler and all data were recorded under the individual log number by both scaler and lumber grader. A third man was stationed behind the saw to mark the boards from each log so that they might be properly identified by the grader. The grading was done behind the trimmer and the footage of each lumber grade produced from each log was recorded. The contents of the boards were calculated by the grader, and the dimensions were not recorded. The lumber grading rules of the California Sugar and White Pine Company were followed. All lumber below No. 3 common was recorded as cull and not included in the tally as merchantable.

It has been found that studies of this character can best be made at a single mill. A double mill, or a mill with a resaw, so complicates the work that it cannot be done successfully. The mill employed in this study was a typical single-band of moderate capacity, with a daily output of about 60 thousand feet, broad measure. The band saw kerf was about 3/16 inch and the kerf of the edger saws was 5/16 inch. Utilization in the mill was close, as boards down to 3 inches in width and 4 feet in length were saved. An extra width of ⅛ to ½ inch was allowed on all boards and an extra thickness of ⅛ inch was allowed on all lumber except inch common and ties. A very considerable part of the common lumber was put into sawed ties. This led, in part, to the rather considerable overrun of the lumber tally over the log scale. A comparison of the per cents of overrun for the different log grades may be obtained from the following table, which shows as well the scope of the study:

Summary of Lumber Tally.

Class of Logs	*No. Logs*	*Scale Feet B.M.*	*Tally Feet B.M.*	*Per cent of Overrun*
Total Grade I	198	130,120	133,943	2.9
Total Grade II	604	289,640	312,976	8.1
Total Grade III	2,860	455,090	553,003	21.5
Total all logs	3,662	874,850	999,922	14.3
Sound logs—no ties	2,685	667,450	746,210	11.8
Sound logs—ties	868	174,690	218,294	24.9
Total sound logs	3,553	842,140	964,504	14.5
Total defective logs	109	32,710	35,418	8.3

As shown in the table, this study covered practically one million feet of lumber cut from 875,000 board feet of logs, with an average overrun of 14.3 per cent. This is the highest per cent of overrun obtained at any mill tally in California. The higher quality logs gave only a comparatively small amount of overrun, because of large size, slight taper and the production of a greater proportion of thin lumber. The greatest overrun occurred in logs of poor quality, because the majority of Grade III logs are top logs of small size and heavy taper. The logs from which ties were cut gave over double the overrun of those producing no ties. The overrun secured from defective logs was somewhat less than that for sound logs. The total lumber tally from defective logs was 12.5 per cent less than their gross scale. Rough notes kept on waste determined that about 68 per cent of the solid wood contents of the logs actually went into boards.

The determination of overrun, or total lumber contents, is only a secondary purpose of these studies. The primary object is to ascertain the volumes of the logs in lumber grades. In this case the lumber produced from the 3,662 logs involved produced 25.3 per cent of uppers; that is, No. 2 shop and better. This amount is about normal for the yellow pine on the east side of the Sierras, and the stand from which the logs came may be considered as quite representative of the region. The essential differences between the three log grades are well illustrated by the lumber tally. Grade I logs produced the bulk of the clear, while Grade II logs ran less to clear and more to shop, and Grade III logs cut little clear or shop. The per cents of the various lumber grades comprised in the total lumber tally were as follows:

Grade of Logs	*1 and 2 Clear*	*3 Clear*	*C Select*	*Australian*	*1 Shop*	*2 Shop*	*3 Shop*	*1 and 2 Common*	*Box*	*3 Common*
I	21.5	3.6	11.3	5.9	8.0	8.9	3.9	28.4	7.4	1.1
II	2.7	1.7	2.2	0.7	12.8	24.2	9.4	37.5	7.7	1.1
III	0.2	0.1	0.6	0.2	1.4	4.1	4.3	77.1	10.5	1.5
All	3.8	1.	2.6	1.1	5.8	11.0	5.8	58.3	9.3	1.3

These per cents may be used in estimating the quality of standing timber by simply tallying the total estimated scale in each log grade on a sample area. However, it is apparent that a more accurate estimate may be made by using both log diameter classes and grades as a basis. Therefore, in the office compilation of results, the data were assembled by log grades and diameters, and the log scale and cut of each lumber grade summarized for each log diameter. Tables were then prepared showing the amounts and per cents of the various lumber grades obtained from each diameter class of logs. Finally, these

results were adjusted by the construction of curves and volume tables prepared, giving the average contents of logs of each grade and diameter class in per cents of the principal lumber grades. Thus, three final tables were obtained, one for each log grade. The table for Grade I logs is given below as an example of the results obtained.

Per cents of Lumber by Grades. Sound 16 Foot Grade I Logs.

Diameter Inches	1 *and* 2 *Clear*	3 *Clear*	*C Select*	*Australian*	1 *Shop*	2 *Shop*	3 *Shop*	1 *and* 2 *Common*	3 *Common*	*Box*
22	19	2	9	5	6	7	2	46	..	4
23	19	2	10	5	6	7	3	44	..	4
24	19	2	10	5	7	8	3	42	..	4
25	19	2	10	5	7	8	4	40	1	4
26	20	2	10	5	7	9	4	38	1	4
27	20	2	10	6	7	10	4	36	1	4
28	20	3	10	6	8	10	4	34	1	4
29	21	3	10	6	8	10	4	33	1	4
30	21	3	10	6	8	10	5	30	2	5
31	22	3	10	6	9	10	5	27	2	6
32	22	4	10	7	9	10	5	25	2	6
33	23	4	10	7	10	9	5	23	2	7
34	23	4	10	7	10	9	5	22	2	8
35	22	4	11	8	10	9	5	21	2	8
36	22	4	11	8	11	8	5	20	2	9
37	22	4	11	8	11	8	5	20	2	9
38	22	4	11	8	12	8	5	19	1	10
39	22	4	11	8	12	8	4	19	1	11
40	22	4	12	8	12	8	4	18	1	11
41	22	4	12	8	12	8	4	17	1	12
42	22	4	12	8	13	8	4	16	1	12

EFFECT OF DEPTH OF COVERING SEED UPON THE GERMINATION AND QUALITY OF STOCK

By S. B. Show

Forest Examiner, Feather River Experiment Station

The Feather River Experiment Station has completed a series of experiments on the effect of depth of covering seed upon germination and quality of stock. The species included in the experiment were western yellow pine, Jeffrey pine, sugar pine, Douglas fir, white fir, and bigtree. With the exception of sugar pine, which has been sown both in the spring and fall, the conclusions regarding all the species are based on spring sowing only.

Sugar Pine

Spring Sowing—The results fall into two groups: Sowing to ¼ inch and ½ inch may be considered together, and ¾ inch and 1 inch together.

The shallower sowing gave five times as many seedlings the first year as the deeper sowing; the winter loss was heaviest in the shallow sowing; the amount of holdover germination was the same for both shallow and deep sowing. The net result shows nearly twice as many 2–0 seedlings from shallow as from deep sowing.

Fall Sowing—For the period of active germination, two groups as before. During the period of growth and loss the ¾ inch joined the shallow group. Shallow-sown seed started germination and reached the peak of germination two weeks earlier than deep-sown seed. The final count shows the ¼-inch, ½-inch and ¾-inch sowings with an average of 185 plants per drill, while the 1-inch sowing has 140.

In the fall of 1915 the plants were lifted from 2 feet of drill from each lot of both spring and fall sowing, and the plants graded into firsts, seconds, and culls. The average weight and length of the tops and roots of each lot of firsts and seconds was carefully determined.

Table 1 summarizes the results of the grading:

Table 1

	Spring Sowing 2–0 Stock			*Fall Sowing 1½–0 Stock*		
Depth, Inch	*Total Per Foot*	*No. Firsts Per Foot*	*Per cent Firsts*	*Total Per Foot*	*Firsts Per Foot*	*Per cent Firsts*
¼	42.2	26.2	62.1	48.0	24.7	51.4
½	45.2	21.0	46.5	47.5	27.6	58.0
¾	25.0	12.5	50.0	45.0	26.2	58.3
1	21.7	12.7	54.2	35.0	20.2	57.8

Table 2.—*Average Weight of Firsts in Grains*

	Spring Sowing 2–0 Stock			*Fall Sowing 1½–0 Stock*		
Depth, Inch	*Weight of Tops*	*Weight of Roots*	*Total*	*Weight of Tops*	*Weight of Roots*	*Total*
¼	1.70	0.58	2.28	1.03	.39	1.42
½	1.50	0.50	2.00	1.03	.40	1.43
¾	1.43	0.40	1.83	1.24	.55	1.79
1	1.21	0.44	1.65	1.16	.52	1.68

It would thus seem that in the case of spring sowing shallow covering (¼ inch to ½ inch) is advisable because of higher germination the first year; greater total number of plans per foot produced in seed beds; greater number of firsts per foot produced; larger size and better development of firsts.

The striking differences in behavior from spring sowing do not occur in the case of fall-sown seed. In the case of fall sowing, covering to ¼ inch, ½ inch, and ¾ inch gave practically the same number of firsts per foot; sowing to ¼ inch, ¾ inch, and 1 inch gave stock of the same total length, but that from the deepest sown seed had too heavy a top for the roots. Sowing to ½ inch gave somewhat the largest stock; using weight as an index of stockiness, the seedlings from ¾-inch sowing are the best, from 1-inch next, and from ¼-inch and ½-inch last; sowing to 1 inch is not recommended because of the smaller number of first produced and the poorly balanced stock produced; sowing to ¼ inch, ½ inch and ¾ inch give about equally good results, with the last two possibly a trifle better than ¼ inch.

Western Yellow Pine

Briefly, the important points are these: The shallower the sowing the sooner germination started; the deeper the sowing the more complete was germination; the deeper the sowing the more rapid was germination after it once really started; the largest proportion of delayed germination occurred in the ¼-inch and ½-inch sowing.

Germination data alone do not tell the whole story, since such figures must be interpreted in terms of the quantity and quality of stock produced. In other words, the real index of the value of the different depths of sowing is the amount, both relative and absolute, of first-class stock produced under the different conditions.

Table 3 summarizes the essential data regarding quality and quantity of stock:

TABLE 3

Depth of Sowing, Inch	*Total Number Per Foot as 1–0 Stock*	*Number of Firsts Per Foot*	*Per Cent of Firsts*	*Relation Total Number at ¾-inch to Other Depths*	*Relation Number of Firsts at ¾-inch to Other Depths*
⅛	30.0	21.9	72.9	52.2	79.8
¼	40.2	23.4	57.7	70.0	84.8
½	48.0	28.1	57.5	83.6	101.8
¾	57.5	27.6	48.1	100.0	100.0

From this table it is evident that there is a wide range in the total number of seedlings produced by different depths of sowing, but very little difference in the number of firsts. Thus the total number produced by covering ⅛ inch is only half as great as from ¾ inch, but the number of firsts is 4/5; that if it is admitted that the best criterion of the quality of stock is the number of firsts, then ½ inch is the best depth of sowing; that yellow pine shows great adaptability. Very nearly the same number of firsts per foot of drill were produced by all depths of sowing, in spite of a variation of nearly 100 per cent in the total number of plants from shallow and deep sowing.

The firsts from the different depths of sowing were of the same average size and quality.

The optimum depth in case of spring sowing is thus ½ inch; sowing to ¾ inch also gives good results. Shallow sowing (⅛ inch and ¼ inch) is 80 per cent as effective as deeper sowing.

Jeffrey Pine

For Jeffrey pine it was found that germination starts only five days earlier with shallow-sown seed; that the peak of germination is the same for all lots; that seed sown to ½ inch and ¾ inch may be considered as one group (No. 1), as may that sown to ¼ inch and 1 inch (No. 2); that the total germination of group No. 1 is 50 per cent higher than for group No. 2; that the deeper the sowing the higher the per cent of total germination in the period of active germination.

The real test of the value of different depths of sowing is the number of firsts per foot of drill produced. This is shown in Table 4:

TABLE 4

Depth of Sowing, Inch	*Total Number Per Foot as 1–0 Stock*	*Number of Firsts Per Foot*	*Per Cent of Firsts*
¼	44.3	31.0	70.0
½	61.7	39.3	63.7
¾	50.5	29.7	58.8
1	37.3	26.4	70.8

The average size and development of firsts was the same for each lot.

It is evident that ½ inch gives much the best results, and sowing, when done in the spring, should be to ½ inch.

Douglas Fir

This experiment has been carried out twice, beds having been sown in the spring of 1913 and the spring of 1914.

The 1913 experiment was somewhat complicated by loss in the ⅛-inch and ¼-inch lots, caused by birds. Barring this loss, the total number alive at the end of the season should have been considerably greater than it was. The following conclusions seem warranted: The shallower the sowing the sooner germination starts; the shallower the sowing the more rapid and complete its germination.

In Table 5 is given the number and per cent of firsts averaged for two years (1913 and 1914):

TABLE 5.—*Average of* 1913 *and* 1914

Depth of Sowing, Inch	*Total Number*	*Number of Firsts*	*Per cent*
⅛	47.0	19.8	41.9
¼	40.5	16.9	43.8
½	29.6	15.7	53.5
¾	17.3	10.3	55.0
Average	33.7	15.8	48.5

It is evident that the total number and number of firsts per foot decrease with increase of depth. Both these figures for ⅛ inch and ¼ inch are above the average for all depths; that the percentage of firsts increases with increased depth.

The effects of different depths of covering upon the survival of stock (1–1) in the transplant bed may be judged from the following results: In the case of ⅛-inch cover, 28.7 per cent were alive after one year; ¼ inch, 26.8 per cent; ½ inch, 20.3 per cent; ¾ inch, 18.9 per cent.

Shallow covering (⅛ inch and ¼ inch) in the case of spring sowing is better than deep sowing (½ inch and ¾ inch), because the total number of plants and of firsts per foot of drill is greater, firsts average larger, and loss in transplanting is lower.

White Fir

The germination data for white fir warrant the following conclusions: The shallower the sowing the sooner germination starts; the shallower the sowing the more complete is germination.

Table 6 summarizes the data from grading 1–0 stock of the several lots and the average weights of tops and roots:

TABLE 6

Depth of Sowing, Inch	*Total Number Per Foot*	*Firsts Per Foot*	*Per Cent of Firsts*	*Total of 25 Plants* Weight Tops, Gr.	*Weight Roots, Gr.*	*Total Weight, Gr.*
1/8	43.0	27.0	62.8	4.26	1.62	5.88
1/4	31.2	16.9	54.0	3.90	1.20	5.10
1/2	12.9	7.1	54.8	3.85	.95	4.80
3/4	3.8	1.9	48.9	3.82	1.07	4.89
Average	22.7	13.2	55.1	3.96	1.21	5.17

This would seem to indicate that very shallow covering (1/8 inch) in spring sowing gives the best results, because the total number of plants and number of firsts per foot is greater than for other depths, the number of firsts is twice the average, the average size is greater, and development (using weight as an index) is better than for other depths.

Bigtree

The germination data indicate that the shallower the sowing the greater amount of germination, both in the first and second years; that the holdover germination is very high (from 80 to 95 per cent of the total), and that the very shallow covering (1/8 inch) gives nearly three times as many seedlings at the end of two years as the closest competitor (1/4 inch). Incidentally, the large amount of holdover germination indicates fall sowing for this species.

BRAZILIAN WOODS: THEIR UTILIZATION FOR THE MANUFACTURE OF WOOD PULP[1]

The writer has more than once had occasion to traverse the forests of several of the coastal regions of Central Brazil, and to stay for months together in these regions. Some of them are exceedingly mountainous; on leaving the littoral the ground abruptly becomes very much broken, and is almost always heavily wooded. One sees at first what the Brazilians call *capoeiros,* which extend for a mile or two from the coast; then comes the real virgin forest. The other regions, especially towards the north, consist of sloping shores of a greater breadth—perhaps 15 miles or so—giving place to low hills crowned by plateaus known as *chapadas,* the whole covered thickly with timbers. The states of Rio de Janeiro and Espirito Santo possess together an area of approximately 60,000 square kilometers—say, 23,000 square miles—of forests. Considerable portions of these forests, in the proximity of communication facilities, have been stripped of the valuable woods which they contained, such as red cedar, figured poroba, redwood, balsamwood, lemonwood, Brazil hickory, mahogany, tobacco ebony, black rosewood, real rosewood, cow-wood, Brazilian oak, yellow boxwood, goldwood, and others. Other parts, little explored yet readily accessible, still hold a great quantity of these costly woods. A French company has just been found to exploit a forest region with an area of over 3,800 square miles for, in particular, the cabinet woods which they contain.

In addition to the valuable essences, the construction timber and the timber for railway sleepers, a large number of species are found in all these forests which have absolutely no industrial applications; some of them might perhaps be of use as firewood. It is among such species that the writer looked for those which would best lend themselves to the manufacture of wood pulp.

Woods Suitable for Pulping

The following are the native names of the species which, in the writer's opinion, are best adapted for that purpose. It is to be regretted that neither in French nor in English is there any name for so many species: Lenha branca, morceguinho, cachete bicuyba, imbira guiaba, gindyga, araçá, anda-assú, tatú, barriga d'agua, almecega, catingo de

[1] Reprinted from the London Times, South American supplement.

porco, pindahyba, imbaúba, aça, cajá, canella jacú, canella gosmenta, taromá, gotrana, mulungú, sapucaia, figueira de campo, conde, louro, imbriussú, guaxima, bacurubú, palmito doce, bainha-capada, pinho do Paraná.

Most of these are of very rapid growth, and at the age of seven or eight years reach a diameter equal to that of our European resinous woods at twenty-five years. Nearly all of them have a white or very light-colored physical texture, with long, flexible fibers. Apart from the pinho and the almecega, none of them contains resin. Almost all attain a height of 20 to 40 meters (66 to 112 feet) and a diameter of 75 centimeters to 2½ meters (say, 30 to 100 inches), with the exception of the guaxima, which is a shrub.

Analysis of Some of the Woods

	One Month after Felling			*Dry timber*	
	Water, Per Cent	*Ash, Per Cent*	*Cellulose, Per Cent*	*Ash, Per Cent*	*Cellulose, Per Cent*
Canella gosmenta	34.22	0.71	48.02	1.08	72.99
Canella jacú	38.61	0.61	43.75	1.00	71.26
Taromá	32.94	1.29	46.07	1.93	68.70
Gotrana	33.32	0.75	45.75	1.12	68.61
Mulungu	54.53	1.24	30.99	2.74	68.16
Imbauba	28.92	0.93	47.71	1.31	67.12
Sapucaia	33.57	0.38	44.25	0.58	66.61
Figueira do campo	39.33	1.54	40.39	2.54	66.58
Conde	31.67	0.79	44.31	1.15	64.85
Imbirussu	40.70	0.81	37.52	1.36	63.28
Guaxima (bark)	54.82	5.38	12.77	11.90	28.27
Guaxima (wood)	43.56	1.03	34.81	1.83	61.67
Bacurubu	23.13	1.59	46.54	2.07	60.55
Palmito doce	30.43	0.83	40.50	1.19	58.22
Bainha-capada	41.77	1.05	31.36	1.80	53.86
Louro	19.37	2.74	52.17	3.40	64.70

Volume and Distribution

The writer has carried out a large number of estimates of the volume occupied by these white woods. In a general way, it may be said that it decreases in inverse ratio with the altitude in tropical forests. Thus the writer has measured in forests at an altitude of less than 100 meters 550 cubic meters of white wood per hectare (7,862 cubic feet per acre), while at 250 or 300 meters (say, 825 to 1,000 feet) the proportion is no more than 200 cubic meters (2,860 cubic feet per acre). At a height of 500 to 600 meters (say, 1,700 to 1,900 feet) it falls below 100 cubic meters per hectare (1,430 cubic feet per acre). These figures relate to squared trunk wood; no account is taken of the branches or of the exterior wood, which by themselves form a volume equal to nearly one-half of that of the trunk wood.

The specific gravity of all these woods is very variable, ranging between 0.350 and 0.750, so that on an average a cubic meter would weigh 550 kilograms (1,212 pounds), and would yield about 200 kilograms (441 pounds) of mechanical pulp, or 125 to 150 kilograms (275 to 330 pounds) of unbleached chemical pulp.

Conditions of Exploitation

The conditions of exploitation naturally depend upon the topographical situation of these forests. It is possible to come to an agreement with the proprietors or with the companies which exploit the cabinet woods only, or to acquire certain of the forests and work them as a whole. On this would depend the net cost per cubic meter of wood delivered at the mill. It is impossible to state an average value per cubic meter; the writer will merely give, as a guide, an example corresponding to an industrial exploitation of relatively little importance, of which the mills are situated at a short distance from a navigable river connected with a seaport.

Whether the wood is worked by the enterprise or whether it is purchased from the exploiters, let it be supposed that its cost, delivered to the mills in the proximity of the river, is 3f. 50c. (2s. 11d.) per cubic meter. Let it also be assumed that the cost of labor is 6f. (5s.) per day of 10 hours, with 300 working days per year. This being so, let us calculate what would be the cost price of 100 kilograms (220 pounds) of mechanical pulp for an output of 20 tons of pulp per day. This works out as follows:

Estimated Cost

Motive power: 1,500 h.p., produced by burning wood chips, etc., the net cost of which would be 1f. (10d.) per cubic meter.

	F. c.
Of this fuel 60 cubic meters per day would be necessary—60 f., or for 100 kilograms of pulp	30
For 100 kilograms of pulp ½ cubic meter of white wood is sufficient, or	1.75
Labor: in mill, 50 men at 6 f.—300 f.—for 100 kilos	1.50
Land transport, 20 men at 6 f.—120 f.—for 100 kilos	60
Ten mules at 2 f.—20 f.—for 100 kilos	10
River transport (100 h.p. steam barge, 400 tons, with crew of 10 men) would cost about 20 f. per 20 tons manufactured—for 100 kilos	10
Lighting, oil, etc.—25 f. per day—for 100 kilos	12
Management and staff—150 f. per day—for 100 kilos	75
Amortization of capital—800,000f. amortized at the rate of 15 per cent per annum, or per working 400 f.—for 100 kilos	20
	F. 5.42

This cost of F. 542 per 100 kilograms ($5^3/_{20}$ d. per 220 lb.) is for pulp delivered at the port of exportation. To this must be added:

	F. c.
Transhipment aboard steamer, per 100 kilos	20
Export duties, 10 per cent, *ad valorem*	55
Freight from Brazil to an English port, 20s. per ton, or for 100 kilos	2.50
Cost of 100 kilos. pulp f.o.b. at an English port	F. 8.67
The present selling price of pulp per 100 kilos being	13.00
There is a net profit of	F. 4.33

If this calculation be correct, the annual profit should be 260,000f. (*i. e.,* 3s. 5d. per 220 pounds, or £10,292 per annum).

Capital Necessary

The capital necessary for this enterprise is made up as follows:

Machinery, 1,500 h.p. (for wood fuel)	F. 150,000
Apparatus: rasping machines and accessories	200,000
River steamer, 400 tons capacity	125,000
Barges	200,000
Transport and setting up	50,000
Sundries and unforseen expenses (the land is given free)	75,000
	F. 800,000
Floating capital	400,000
Total capital	F. 1,200,000

The profit would thus be about 21 per cent on the total capital.

It will be remembered that in the foregoing calculations it is assumed that the wood is supplied by an exploiter at the price of F. 3.50 per cubic meter delivered at a certain distance from the mills, and that the pulp manufacturers have only to load it and transport it by a Decauville light railway to the factory. If the forest were to be exploited by the manufacturers themselves, the business would be rather more complicated; it would, of course, be necessary to sink more capital in extraction material, "penetration" railways, labor, and so on, but this would be largely compensated by the proceeds of the construction and cabinet woods found.

REVIEWS

Some Public and Economic Aspects of the Lumber Industry. By William B. Greeley. Report No. 114, Department of Agriculture. Contribution from the Forest Service. 1917.

This report by Mr. Greeley is perhaps the most important contribution to the economic literature of forest industry ever issued by the Forest Service. Although the information presented has existed in scattered form among the various leaders and students of the industry, this report brings together for the first time in a unified whole definite and reasonably accurate information as to the status of the industry. It is bound to be of tremendous value to foresters, and so far as it obtains general circulation, will serve to correct many mistaken ideas on the part of the public. Obviously, such service is of prime importance to the lumber industry itself.

It is, of course, not to be expected that all will agree as to the conclusions reached. In some respects these conclusions are not in line with the best economic authorities. It seems to be assumed, for example, almost as an axiom, that speculation is always and uniformly an evil. For instance, in the introduction it is stated (page 4) that "the public is not concerned with the security of timber investments or the outcome of speculative ventures." As a matter of fact, the public is concerned from more than one standpoint. In the first place, timber investments, while perhaps not so widely scattered as those of better organized industry, such as railroad transportation, are very general. A large section of the public is therefore directly concerned with the security of these investments from the standpoint of the investor. The concern of the consumer is, however, paramount. The frequent failure of timber investments makes the investment of capital in the industry precarious. The interest rates are therefore high, and since interest always forms one of the large costs in industry, this cost must be charged on to the consumer in unduly large amount. Security of timber investments is an absolute prerequisite to the reduction of interest rates in the industry and the saving of large sums thereby. It is a further fact that in a pioneer state as the United States has been speculative capital is by far the most important body of capital available. Speculative capital built our railroads, our telephone and telegraph lines, and develops every new industry. Our progress is abso-

lutely dependent upon it, and however much the unthinking portion of the public may fail to appreciate it, this attitude should not be indiscriminately followed in a responsible publication. There are, of course, forms of speculation which should be suppressed, but it is an undoubted fact that so-called speculation in timber has performed a tremendous public service. The willingness of foresighted individuals to acquire and conserve large bodies of timber for future use formed a forerunner of public appreciation of our forests, which were formerly supposed to be inexhaustible, and therefore requiring no care. This appreciation of forest values brought about the rapid rise of stumpage values in the West pointed out by the report. It was largely instrumental in bringing about the setting aside of the remaining public forests as National Forests. It was also an absolute prerequisite to the formation of the forest fire associations, which began the general protection of private timber lands about 1907, when stumpage values, after the rapid rise of several years, reached the level where it was obviously good business to spend money in protection of these values. Leading foresters have often stated that adequate stumpage values are necessary before the practice of forestry can begin. Why decry the process which brought about these values quickly and brought about some practice of forestry while we still had the forests? The long run interests of the public have been served thereby. What should be made clear is that, notwithstanding the great service of speculative capital in the past, when the possibilities of the industry were unproved and conservative investment capital was unavailable, the time for speculative organization and management is now past. The urgent need is to put the industry on a conservative investment basis throughout, with the low interest charges incident thereto.

The report rightly points out that the main problem of forest industry is the management of the remaining forests. The present management of private forests on a purely exploitation basis has brought about and is bringing about overdevelopment of the exploitation end of forest industry. This gluts the market, and in ordinary times results in price demoralization, low remuneration or loss of capital, and general disorganization of the industry. This management creates the impression that there is an oversupply of standing timber from the standpoint of the public as well as the timber owner—an impression which is entirely incorrect, but generally leads, nevertheless, to the waste of forest resources through cutting in excess of market demands, through selecting the better classes of material while leaving poorer qualities

as woods and mill-waste; in short, a general train of results well known to all students of the industry.

The report shows that the widespread character of the industry, with its 49,000 plants, cutting 40 billion feet of lumber annually, distributed over all the forest regions of the country, makes better organization of the industry difficult. Practically speaking, the industry is overdeveloped in the regions most accessible to market, which leads to early exhaustion of supplies and the consequent removal of the bulk of the industry to more distant regions.

The question of timber ownership is dealt with extensively. It is recognized that in the East, in the Lake States, and even in the South, the supplies of standing timber, although mostly in private ownership, probably do not constitute an excessive burden on the private owner. The West, it is pointed out, has in private hands 888 billion feet of privately owned timber, while the annual cut has never exceeded 9 billion feet. There is thus about 700 billion feet of timber in private hands in excess of what the present annual cut would remove in twenty years. It is assumed by the report that a twenty years' supply of standing timber is all that a sawmill can carry. If this assumption be correct, of course there is no possibility for private forest management in existing forests, because the rotation length must be at least fifty to sixty years in our best forest growing regions. The reviewer would add that while it is undoubtedly true that the value of the standing timber in a forest organized for sustained annual yield, with a proper distribution of age classes, would be less than the value of twenty years' cut of equal annual amount all stored up as mature timber, nevertheless we have no forests with proper distribution of age classes, and must begin forest management, if at all, with masses of mature timber, for the most part. The condition is somewhat mitigated by the fact that there are some young age classes following fires, and that there are bodies of inferior species of low capital value which can be reserved for the later years of the first rotation, and that there are inaccessible stands which will serve like purposes. With these mitigating circumstances, which, as a matter of fact, are present nearly everywhere in the West, the reviewer is of the opinion that a mill company can carry sufficient timber to work under sustained annual yield, the chief bar to such action being the high interest rates still maintaining in the industry, largely as a result of its highly competitive condition. While speculative capital has served well the public

through the lumber industry in the past, it is now time for it to leave the stage and for the industry to be put on a conservative investment basis throughout, under which the cost of capital should be reduced to 4 or 5 per cent in place of 6 to 7 per cent, the present interest rates.

The conclusion that a mill cannot carry more than a twenty years' cut of standing timber with 7 per cent capital may be correct, but it is erroneous to conclude that it is impossible to so organize forest industry as to put it on a conservative investment basis. That, in effect, is the real meaning of the recommendations of the report—that the ownership of forest resources must be put on a stable basis. In dealing with the question of carrying charges on timber, the report shows that interest figured at 6 per cent is the heaviest item of cost. In the field of returns in lumber manufacture it is shown that prices have been fluctuating, and profits and losses equally so as a consequence. It then deals with returns in lumber distribution, under which heading it is stated that the charges for wholesaling lumber appear to range from 50 cents to 90 cents per thousand feet. When this function is performed by the middleman it costs more than when done directly by the manufacturer. The charge for retailing lumber in the Middle West is from $4 to $6 per thousand feet, out of which the dealer makes a profit of from 75 cents to $3. The returns to retailers are higher in the country than in the city, and somewhat better all around than those earned in manufacture.

One of the most instructive sections of the report deals with the cost of lumber to the consumer. In this section it is shown that a fifth or more of the cost to lumber consumers consists of transportation cost; that the retailer takes about the same amount, while on the average manufacturers get a little more than half. The rise in lumber prices has not been great different from those of most commodities, and since 1907 lumber has fallen behind. One of the most important causes of the rise in lumber prices in certain sections, which is scarcely emphasized enough in the report, has been the exhaustion of local supplies and the necessity of bringing supplies from distant forest regions. Due to this cause, higher and higher freight charges have continually to be added to the cost of lumber to the consumer. It may be said also that where lumber comes from distant regions the intervention of the middleman, with his charge of $4 to $6 per thousand, is almost always necessary, whereas so long as supplies are local most lumber is sold directly by the manufacturer to the consumer. The transportation and

the middleman's charge together amount to from $10 to $20 or more per thousand feet. The report might have emphasized more strongly that in natural forest regions the saving of these costs by local production of timber will pay a high and profitable stumpage price on such production, to say nothing of the additional price which might logically come from adding the stumpage price at the distant source of supply. Or the alternative in such regions may be cheaper lumber and more moderate profits from forestry. In the final analysis, the high cost of lumber across the northern belt of States east of the Mississippi River is in very large part due to failure to keep forest resources of that region on a continuous producing basis. This logic might be followed still further to show that the rapid rise in the cost of lumber due to this local exhaustion brought about the prevailing ideas of the presence of a lumber trust. This idea, together with the opinion that lumbermen have been destroying the resources with which they are entrusted, has been the cause of a large amount of public hostility to the lumber industry, which has gone even so far as to be reflected in legislation, and some other past activities of government designed to embarrass rather than assist the industry.

One gains the impression from many passages in the report that the author believes the most desirable form of industrial organization is that which insures the most competition. In view of the vast volume of modern thought which seriously questions the economic expediency of the untold wastes of the competitive system, it is somewhat astonishing to see it taken as axiomatic that this system should be maintained without restriction, or even by intervention of the Government if necessary, to prevent more centralized organization.

The attempt is also made to show that the use of substitutes is cutting into the market very seriously, but the method of attack of this problem by no means makes this opinion conclusive. It is hardly a sound method to urge all materials of construction in place of which wood could be used are in the nature of substitutes for wood. It would be equally sound to say that in all cases where brick might be used instead of the prevailing material—wood—that wood is a substitute. Brick and stone are, in fact, just as time-honored materials of construction as is wood, and it is impossible to claim a certain amount of the construction field for one class of material only and to say that others are substitutes. Better economic organization, especially in dis-

tribution, may be expected to enlarge the market for wood, though former per capita consumption may not again be brought about.

To the forester one of the most gratifying passages is in regard to sustained annual yield from National Forests (page 99), where it is stated: "The industries supported by National Forest timber, however, should be permanent, not the migratory sawmill of old lumbering regions. Hence the cut of timber should not exceed the growing capacity of the forest areas tributary to various manufacturing centers." The literal carrying out of this policy will correct a hitherto weak spot in National Forest policy.

The report is itself a summary of an extensive investigation, and it is impossible to touch on the many important points that it covers. Suffice it to say that to be well informed in their field foresters or lumbermen must without question be familiar with this report.

B. P. K.

The Theory and Practice of Working Plans (Forest Organization). By A. B. Recknagel. Second Edition. John Wiley & Sons. New York. 1917. Pp. 1-265, 6 photos, 2 figs. Price $2.

The second edition of Recknagel's "Theory and Practice of Working Plans" now carries the short title on the back of the volume, "Forest Working Plans," in order to obviate the possible confusion with House Working Plans. This is an improvement.

As explained in the preface to the second edition the revised version is improved (1) by standardizing nomenclature and definitions in accordance with the S.A.F. committee report for which Recknagel worked painstakingly, (2) by adding "Correlation of Silvicultural Methods, and Methods of Determining the Cut," and (3) by profiting from criticisms, teaching experience, and current forest literature. On the whole Recknagel is to be congratulated on the improvements made. He is handicapped, however, by the lack of working plan development in the United States and the consequent dearth of material and experience to draw upon. Evidently the author feels much the same way about the application of silvicultural methods, rotations correlation of regulation methods with reference to species or forest types, for he states (p. 2): "The time is not yet ripe for such generalizations; they must wait until the practice of forest management in America has advanced further than today." In collaboration

with Professor H. H. Chapman the reviewer is now engaged on a book to be entitled "American Forest Regulation," in which working plans will be given but scant attention for the same reasons. Recknagel also cites reasons for omitting the philosophy of rotations. But there is vastly more to be found about rotations in American forest literature and practice than there is about working plans. So it is evident under what a handicap the author of Forest Working Plans has been laboring. Therefore all the more encouragement is due him for contributing to a subject *which every branch of the profession has neglected* thus far in our forest history. Hutton (a recent graduate of Yale), has been about the only American forester to produce (in 1916) even a preliminary plan for a National Forest along sound lines (Olympic Forest, District 6), that may be applied. Possible exceptions are the working plans made each spring by the senior class of the Yale Forest School, but these are for private tracts and are not applied.

Recknagel's discussion of the normal forest is greatly improved over the first edition; diagrams A and B are excellent, although he might have introduced a curve into diagram A (p. 2) showing the trend of mean annual growth (for a given species and site) as a basis for comparison with the line A C. Perhaps a little more philosophy could have been lavished on the *economy* of using Flury's constant (pp. 9, 10, 11). There is still a painstaking description of methods of regulating the cut (18 in all). In commenting on the first edition Sir William Schlich criticised this multiplication of methods but it is simply the German systematic method of covering everything as opposed to French simplicity. The German will describe (Mayr for example) perhaps 28 formal methods of reproduction; the French forester will describe but three or four (coppice, clear cutting, selection), and then indicate how these may be varied by describing possible combinations. It is simply the difference in national methods and at present the reviewer is rather "pro-ally"!

Diagram E (p. 125) representing the determination of cut by 18 different methods is interesting, but the comparison is not convincing because of the variation in results between certain formula methods of regulating the cut according to the amount of the actual growing stock as compared with normal in the specific example used. With different figures a different degree of divergence would have been secured.

In describing the Austrian formula (p. 78) it is stated: "The period of time in which the actual growing stock is brought to point of nor-

mality is taken as the whole rotation," while according to von Guttenberg (see Roth, Forest Regulation, p. 151) this appears to be a misconception. The Gazon method (France) of regulating the cut with which Recknagel evidently was not acquainted, might have been included since an effort was evidently made to include all possible methods.

The book does not pretend to be a treatise on regulation and certainly there is much about American working plan practice that could not be included *for the simple reason that it does not exist.* But the introduction of even frankly German methods, it is believed, should help foresters in the country to have more enthusiasm for the theory and practice of working plans.

T. S. Woolsey, Jr.

Statistical Yearbook, Province of Canada, Third Year, Section C: Forests, pp. 414–428; *Section D: Forest Industries,* pp. 429–43. Provincial Secretary's Department. Quebec, Que. 1916.

While in the preceding Yearbook Mr. Piché, Chief of the Forestry Branch, discussed at length the administration of Quebec timber lands in all its details, the present volume precedes the statistical part by a short description of the forest of Quebec by Mr. Bedard, Assistant Chief Engineer of the Forestry Service, while Mr. Piché, now under the title Head of the Forestry Service, furnishes only the discussion on the manufacture of woodpulp.

The forests of Quebec may be divided into three zones, namely, two mountain zones, the Alleghany and the Laurentian zone, and the Plain zone between these two mountain or hill ranges. The Plain zone is largely agricultural soil and with some exceptions the forest portions are smaller woodlots of hardwood, sometimes with coniferous admixture, a few larger areas circumscribing properties of the old seignorial concessions. The author makes this zone "the zone of particular trees," whatever this may mean. Among the hardwoods, "walnut" is enumerated, probably butternut is meant. A number of rivers extend the valley and climatic conditions into the mountains, deeper into the Alleghanies than the Laurentians. Only small lumbering operations and the maple sugar industry are here developed, and the forest is recovering the poorer abandoned farms.

The Alleghany zone on the south side of the Lawrence river also contains extensive farm areas. The composition of the forest from

the Chaudiere valley to the coast is chiefly coniferous, spruce and balsam predominating; while west of this valley the forest has the character of the plain forest. In the Gaspé region and near the Metapedia valley the admixture of white birch (paper birch?) is characteristic. In this region private forest property is rather extensive and pulpwood export to the United States comes largely from here, the lack of waterpower restricting paper mill development at home.

Rapid rivers, with many waterpowers and innumerable lakes, characterize the Laurentian peneplain, as well as poorer soils from the glaciated hills. The white pine, which once formed the rich part of the forest in the larger valleys, is nearly cut out. The whole eastern portion of the zone and north of a line from Temiskaming, Shawenegan, and St. Joachim (a short distance north of Quebec), is the home of spruce and fir, replaced by red and gray (jack) pine where the fire has destroyed the original forest. Towards the Atlantic the commercial timber becomes confined to the valleys.

North of the 51st degree of latitude the forest becomes more and more stunted and with the 56th parallel timber limit is reached. Below the 51st degree production of pulpwood is particularly good, a yield of 30 cords being sometimes attained. Here the timber limits of importance are located, both for sawmill and paper mill purposes.

With increased prices and increased pulpwood cut the aggregate value of forest products for the province for the year 1915 had reached almost 30 million dollars, a marked increase over former reports. The pulpwood cut in Canada increased by one third, amounting in 1915 to 1,281,214 cords. In another place this figure is increased to 1,405,835 cords, three times what the cut was in 1908; and Quebec furnished about one half of it, very nearly as much as is being exported to the United States. The author sees in this increased activity "a guarantee that the forest will be exploited more and more economically and more efficiently protected."

Statistics of the operations in forests under license follow, showing that the government secured $1,736,605 for the year, and that the collections since 1867 amounted to nearly 40 million dollars.

To complete the picture of Quebec's forest condition, we may add from the second Yearbook, the figures of interest which Mr. Piché furnished. It should, of course, be understood that all such statements can only be approximations to the truth, an actual stocktaking having been only partially attended to.

The total forest area of Quebec is stated as 130,000,000 acres, 6

million of which only are private, 1.5 million in township reserves and located, and 44.5 million under timber limits, leaving 78 million untouched.

The value of the private forests is estimated at 25 million dollars, with an annual return of around 3 million dollars, in which $700,000 for maple sugar and syrup. Some 231 timber limit holders work the government timber, the average limit being 298 square miles.

The township forest reserves, set aside from the crown lands, of which there are 20 aggregating 267,709 acres, are a special feature of the forest policy of Quebec.

A rather risky evaluation of the forest wealth of the Province is made as follows: 50 billion feet, board measure, of white and red, pine, worth $200,000,000; 125 billion feet, board measure, of spruce and balsam fir worth $250,000,000; 100 billion feet, board measure, of pulpwood, worth $100,000,000; 35 billion feet, board measure, of hardwood, birch, maple, etc., worth $25,000,000; 20 billion feet, board measure, of cedar, worth $25,000,000; total, $600,000,000.

The Forestry Service, as at present constituted, has charge of the exploration of the unsurveyed territory of the Province of Quebec, the classification of soils, the supervision of lumbering operations on crown lands, reforestation and other technical work of the Department in connection with forests.

The present staff consists of the chief forestry engineer, his assistant, 2 civil engineers, 22 forestry engineers, 60 forest rangers, and 14 cullers. In addition, the students of the forestry school are employed in technical forestry work during the summer season.

The yearly legislative appropriation for the Forest Service is $100,000.

B. E. F.

Review of Work of the Commission of Conservation. By Sir C. Sifton. Reprinted from the Eighth Annual Report of the Commission of Conservation. Ottawa, Canada. 1917. Pp. 16.

The annual address of Sir Clifford Sifton, as chairman of the Commission of Conservation, was a statesmanlike statement of the directions in which the Commission and its various branches have been, and should be, advancing in bringing about a better knowledge and a better use of the resources of the Dominion.

At the outset the speaker referred to the war as having removed more than ever from mere academic interest the problems of the use

of natural resources, and as accentuating the importance to the national well-being of aggressive action in their proper use. The need for propaganda in stirring up public interest has greatly diminished, and the Commission may devote its full attention to taking stock of resources and to constructive work. The economic lessons of the war, both the positive ones of German forethought and the negative of England's neglect, were succinctly stated.

As regards food production, national inefficiency and faulty organization is apparent in the fact that the Dominion cannot completely supply her own requirements, and that much of the food is sold at prices far beyond a legitimate commercial basis. The problems of developing more economical use of coal—of which Canada has only a limited supply—is linked with the problems of making available her waterpowers, with which she is richly endowed.

Considerable space is given to the forestry situation, and especially to the work of the Commission in organizing forest-fire protection along the railroads, which "we must attribute largely to the tactfulness, energy, and capacity of our chief forester, Mr. Leavitt."

Advance information is given of the results of the inventory of of British Columbia's forest resources. It appears that of the 250,000,000 acres of forest, 92,000,000 are absolutely forest soil, but only 33,000,000 carry commercial timber, and again half this area is greatly damaged by fire, so that only about 17,000,000 acres remain intact. The total stand is given as 360 billion feet.

In the way of assisting agricultural development, a careful survey of a selected county was made as regards everything that affects the farmers' life, with special reference to the possibility of increasing agricultural production, some obvious lines of improvement suggesting themselves as a result of the survey.

Waterpower surveys, which have been in part reported upon in special bulletins are continued. In this branch of work some international complications have arisen. One of these refers to the illegal diversion from the Great Lakes of a larger than the permitted share of water by the Chicago drainage canal, against which the Commission is invited to protest. A few years ago, a protest of the Commission was successfully entered against the permission to dam the Long Sault rapids of the St. Lawrence, the United States Supreme Court dismissing the company's application.

The problem of exporting electric power and of electric power development at Niagara Falls is also watched by the Commission.

The mining engineer of the Commission was detailed as adviser to the War Purchasing Commission and to other committees having under consideration increased mineral production to supply the needs of the Empire, and in devising new processes of manufacture, several bulletins on coal, nickel, and copper being the result, as well as the installation of additional by-products coke ovens.

In the branch having fish, game, and fur-bearing animals under consideration, an investigation has disclosed the fact that large operations are being organized in the way of exploiting the fur trade of the Northwest, which threaten the extermination of fur-bearing animals. As a result of this finding, the appointment of an advisory board on wild life protection by the Dominion Government has since then been secured, to devise means of checking such an issue.

The fisheries committee finds that some of the most valuable fisheries are in danger of extinction, a matter of serious import. Experiments in the possible utilization of the waste of the fishing industry, conducted through the committee, are promising practical results.

An exhaustive report on the fire waste in Canada was prepared, which reveals the fact that the Dominion has the greatest per capita fire loss of any country in the world of which statistics are available, and the loss is increasing. While from 1890 to 1914 the population increased 67 per cent, the fire loss increased 290 per cent. In the latter year the losses amounted to $21,500, 000, while for fire protection and extinction $45,000,000 were spent. This loss is not due to lack of apparatus, but to lack of building regulations or control.

Still another direction in which the Commission is active through a special agent is in town planning and in improvement of housing conditions. This movement is stimulated by lectures, by organizing civic improvement leagues, by securing the inauguration of town planning acts, and by actually furnishing plans.

It will have appeared from this recital that the activities of the Commission are indeed varied. The Commission is, however, only an educational institution without executive function, and if any improvement is to be inaugurated only its powers of persuasion with administrative authorities can bring it about. The real conservation of resources under such circumstances is only slowly progressing and depends largely on the activity of its influential chairman, who, unfortunately, since the outbreak of the war has been domiciled in Great Britain.

B. E. F.

A Preliminary Study of Climatic Conditions in Maryland, as Related to Plant Growth. By Forman T. McLean. Physiological Researches, Vol. 2, No. 4. February, 1917. Pp. 129-208.

In this study, the author has been able, with comparatively simple methods, and in the short period of time represented by one growing season, to bring out some new relationships between climatic factors and plant growth. The contrasts obtained between a coast and mountain climate will be particularly interesting to ecologists and foresters engaged in the study of the characteristics of mountain climates.

The purpose of the study was to determine some of the quantitative relations between climatic conditions and plant growth in terms of the growth rates of a standard plant, as a measure of the effectiveness of the surroundings to produce growth. A further object was to compare the value of various methods of growth determination from the standpoint of their reliable quantitative expression of climatic differences.

Soy beans up to one month old, from date of sowing, started at intervals of two weeks, were used. They were planted in plunged pots, the same soil being used for all stations. Auto-irrigators were used, thus removing the influence of rainfall. Air temperatures (daily maximum and minimum), evaporation (using cylindrical porous cups), and sunshine were the climatic factors studied.

Two weeks after planting measurements were taken of stem height, average number of leaves per plant, average length and width of mature leaves, and average of the products of length times width for each leaf.

At the end of a month these measurements were repeated and the average leaf area and the average dry weight of tops per plant was determined. Work was continued during almost the entire frostless period, comparing Easton, a point close to sea level on Chesapeake Bay, with Oakland in the mountains in the western corner of the State.

Results.

1. The total efficiency of the Easton frostless season (200 days) was 2.5 times that at Oakland (103 days) measured in terms of leaf product (length and breadth).

2. Stem height, leaf surface, and dry weight showed greater differences in different periods than did number of leaves and leaf dimensions. Rate of growth in leaf surface and dry weight varied alike, while stem elongation varied in a different proportion with changes in external influences.

3. Rate of stem growth was greatest during the first two weeks after sowing, while the rates of growth in leaf surface and dry weight were greatest in the last two weeks of the growth period of four weeks.

4. Growth rates showed unmistakable seasonal marches increasing in the first part of the season and decreasing in the autumn. These marches were most apparent during the first two weeks of growth from seed and were most clearly indicated by increase in stem height. They corresponded in general to seasonal march of temperature conditions.

5. Range of seasonal march for both growth and temperature was greater at Easton than at Oakland, with highest values at Easton. Killing frost occurred earlier at Oakland, but the last period of two weeks before frost at Oakland showed higher temperature and growth values than for the same period at Easton, emphasizing the main differences between a mild equable coast climate and a more rigorous mountain climate, as they may influence plant growth. In the mild coast climate with its low daily range, the frostless season is prolonged until growth is much reduced, or entirely checked by low temperature. In the mountain climate at Oakland, however, with its high daily range and high nocturnal radiation, very low night temperatures and frost occur earlier in the season, while the day temperatures and growth rates of many plants are still high. The maximum of temperature and growth rates occurred a month earlier at Oakland than at Easton.

6. No relation was found between growth rates and either rainfall or evaporation, probably because of auto-irrigation. The ratio of rainfall to evaporation had a secondary relation, however, in that greatest leaf development during second fortnight occurred when this ratio was highest.

7. Temperature was clearly the limiting condition for growth during the first two weeks after sowing, but for the last two weeks, the moisture ratio $\frac{R}{E}$ (rainfall divided by evaporation) appears to have been in many cases the limiting factor, especially with high temperatures. It thus appears that if two plants in different stages of development are exposed to the same fluctuations in environmental conditions, the limiting condition for one plant during a succeeding period may be of an entirely different nature from that for the other. This is probably due to a difference between the internal conditions of the plants at different developmental stages.

While the work is admittedly limited in duration and in the climatic elements studied, the author has succeeded in bringing out some quantitative relationships which will assist other investigators in correlating growth phenomena with probable climatic causes. The study will also be suggestive in showing the comparative use and value of different methods of growth measurement in work of this kind.

D. R. Brewster.

Proceedings of the British Columbia Forest Club, 1916. Volume 2. Victoria, B. C. 1916. Pp. 77-142.

This is a neatly printed volume, containing ten interesting articles, or addresses given before one of the most active forestry clubs, fathered by one of the most energetic forest services. Classifying the contents, we find half the addresses, and also nearly half the pages, devoted to discussions of markets for British Columbia lumber, two articles on logging problems, only two on orthodox forestry problems, and a delightfully written sketch of the life of Indian foresters, by R. H. MacMillan after his own experience. Mr. MacMillan also furnishes an address on "Export Timber Trade," to stimulate which he had been sent around the world by the Dominion Department of Trade and Commerce. In this he explains the attitude of the provincial forest service towards the lumber industry. In view of the discussions now going on in the States over similar conditions, we consider it apropos to quote some of his sentences as suggestive:

"The Provincial Forest Service, in supporting this investigation by the Department of Trade and Commerce, did so because it is realized that wise forest administration in British Columbia depends upon there being profit instead of loss in the logging and lumbering business. . . . .

"Forest administration in British Columbia has not gone beyond preliminary business management and fire protection. It cannot well go farther while the existing stumpage situation exists on the Pacific Coast, where throughout the Douglas fir belt areas of timber (large enough to supply the available markets for the next century) have been allowed to pass into the hands of owners who, in order to rescue their capital or realize their long-anticipated profits, will try to cut in twenty or thirty years.

"It is now realized by foresters on the Pacific Coast that in the stumpage situation they are face to face with a problem even more serious than fire protection, more difficult to handle, and more dangerous. I say more dangerous for the reason that it now lies in the hands of an unorganized, inexpert mob of timber owners on the

Pacific slope, by stampeding to cut their holdings, to cause more loss to the State and the public, by maintaining an overproduction of lumber, than can reasonably be expected from any series of bad fire seasons. I do not depreciate the danger of fires. I simply desire to emphasize that billions of stumpage held by financially weak holders, unaware of market conditions, or determined to take their loss and rescue a part of their investment, constitutes a club held over Pacific Coast forest policy, which, under present conditions, will render it impossible for any government to insist on clean logging or provision for future crops. We all realize that it is over-production of lumber, or, in other words, lack of broad enough markets, that restricts our logging to the cream of the forest, and on even the best tracts leaves a third of the timber on the ground. We all know that while such conditions continue these, the last best virgin forests, will be destroyed without being utilized. Here, then, is the problem for the forester on the Pacific slope."

There is some danger that by catering to the needs of the speculators in timber lands, and it is these, encouraged by the shortsightedness of the Government, who are largely responsible for the situation, that the forest policy of the Province may drop into the background. Is there not also the possibility for the Government of recovering the excess of timber limits bartered away to be considered as an alternative for relieving the situation?

We also consider it dangerous to make such a statement as occurs on the first page in an article by VanDusen, on "Markets for Douglas Fir," in which an argument is made for an increased cut upon the assertion that an annual growth of five billion feet at a conservative estimate may be estimated for the Province. In curious contradiction the next sentence informs us "the difference between this annual growth and the year's cut is not added to the wood capital, however, but is a total economic loss." It is difficult to see what this means. We have as yet not seen any rational basis for estimating the annual increment over a territory like a whole province, still only partially protected against fire. There is, however, no doubt that with a stand of 400 billion feet, the cut of, say, 2 billion feet, can even without any increment be increased considerably beyond the present mill capacity by the 330 sawmills of 2½ billion feet.

We were disappointed in an article by Gilmour, on "Appraisal of Fire Damage in Immature Timber," in which we hoped to find a practical short cut, but found only an elaboration of the usual school prescription of expectancy and replacement formulae. The interesting part of the essay lies in the consideration of the soil value. It is

pointed out that much of the best reproduction is to be found on agricultural soil, which will be cleared before the young growth can reach maturity. Young growth on such land "must be excluded from damage appraisal" unless the soil itself has been damaged. "Lands worth more for grazing and incapable at the same time of producing forage and merchantable timber must also be excluded." For first-class agricultural land a sale price is fixed by the Government at $10, and second-class land has a minimum valuation of $5. The lands which are finally left for forest purposes must be less in value, but as there is no set sale value, and while the land remains vested in the crown, such lands are disregarded by land seekers, and since the data for figuring a soil rent are insufficient, the author considers that no value needs to be placed on them for the present. For his stand expectancy calculations he uses 4.5 per cent and asserts that "a lower rate can scarcely be considered, even by the State."

The two logging articles, each ten pages, are written by experts and well illustrated, namely, one on overhead cable logging, describing a number of combinations, and on log and lumber flumes.

Dr. Howe's contribution was based on his summer's work for the Conservation Commission, a study of regeneration of Douglas fir, with special relation to fire.

Coming to the same conclusion as Dr. Hoffman, that regeneration may be secured from the dormant seed in the soil without the presence of seed trees after a light fire has cleared off weeds and debris, he seems also to subscribe to the dangerous proposition that "you do not need your seed trees; just burn it off lightly and you get your reproduction." Without impugning the findings of the two investigators, in a country where a first fire is rarely left without a successor, we consider even the suggestion of leaving no seed trees criminal. And a second fire is fatal. Dr. Howe found that at least 5 seed trees commonly, and up to 60 were left per acre by the loggers; that salal and salmonberry interfere greatly with reproduction, and that, therefore, even with seed trees, a light fire is desirable. Alder is a retarder, but not a preventer of regeneration. The number of seedlings in stands four years old is given as 500,000 to 700,000, *i. e.*, 12 to 16 per square foot. This can hardly be anything but a mathematical deduction from countings on small areas, especially since the number in the next four years drops to 8,000 to 10,000, in the 20 to 30 year period becomes 1,000 to 1,500, in the 30 to 40 year period, 500 to 800.

The dispersion of seed from seed trees was found to give 3,000 seedlings 5 chains from the tree. At 10 chains this number was reduced to 500, and at 15 to 20 chains it had dwindled to 12 seedlings.

The growth of fir is "like a weed"; under good conditions "it will grow about 1,000 feet board measure per acre per year." A 28-year-old tree was found fit for piles, and a 24-year-old one measured 2 to 4 inches 71 feet from the stump.

Whatever may be said for the use of fire in fir production, it does not work for hemlock, and this is, perhaps, a good way of getting rid of the less valuable competitor.

In conclusion we may be permitted to make one literary criticism. Many of the articles are evidently talks reported by a stenographer. Such talks are, however, rarely in form for printing—there is a difference between spoken versus written language—and should be edited in justice to the authors. The language in informal talks which satisfies the occasion is often crude in construction and would not be used by the author in writing; moreover, the stenographer does not always catch all that is said and adds to the crudities. Here is where an editor's pencil is needed, at least to make the sense clear and the language smooth. B. E. F.

Biennial Report of the State Conservation Commission of Wisconsin for the Years 1915 and 1916. Madison, Wis. 1916. Pp. 160.

Written constitutions are dangerous instruments, and, while intended to be for the benefit of the community, sometimes are really inimical to its welfare. We have seen this as far as forestry progress is concerned in the State of New York, and again constitutional provisions have checked the progress of a sane forest policy in Wisconsin. Here the only rational policy, namely, State ownership, had made considerable headway through purchase of forest reserves by the State Board of Forestry, under contracts, when the discovery was made that the constitution did not allow, and could not be twisted to permit, such a policy. That this was the case was known to the reviewer as long as 20 years ago, when a determined start was to be made to commit the State to such a reserve policy, and he recommended as a preliminary the change of the constitution.[1] It was then found what the State Supreme Court has lately reiterated that the State consti-

[1] See Roth and Fernow: Forestry Conditions of Wisconsin, Bulletin 16, U. S. Division of Forestry.

tution prohibits the State from incurring an indebtedness for sums larger than $100,000 and running for a longer period than five years. The same constitution, curiously enough, prohibits expenditures for "works of internal improvement," and forest reserves, reforestation, or any forestry work might be so considered.

A friendly test case was brought before the State Supreme Court, and on February 12, 1915, the court construed the constitution by letter and decided adversely to the Forestry Board, and the purchases unconstitutional.

The moneys paid out are declared liens upon the properties which should inure to the benefit of the various trust funds, that the State has inaugurated, and which appear to have been interfered with by the forestry legislation. An endless muddle is the result.

There was, however, at least one chief justice who rose above the literal interpretation of the constitution. Although concurring in the opinion of the court, he did not share the doubt in regard to the right of the State to raise taxes in acquiring and handling land as a forest reserve.

Since Chief Justice Winslow's opinion appears to us the only sane one, and the one to which every forester will subscribe, we give extracts from it.

"My difficulty with the opinion (of the court) stated in a general way, is this: It so limits and circumscribes the powers of the State with regard to the afforestation and reforestation that it leaves little more than a shell behind. . . .

"There are three general propositions which I think should be stated in this case clearly and fully, without hedging them about with limitations, qualifications, and provisos which render them practically useless, and those propositions are as follows:

"First, the acquisition, preservation, and scientific care of forests and forest areas by the State, as well as the sale of timber therefrom for gain in accordance with the well understood canons of forest culture, is preeminently a public purpose. It would be a mere affectation of learning to dwell upon the value to a state of great forest areas. That has been established long since and is not open to question. The lamentable results which have followed the cutting of forests over large areas, the serious effects of such cuttings upon climate, rainfall, preservation of the soil from erosion, regularity of river flow, and other highly important things which go to make the welfare of the State, are matters of history.

"Second, before a public purpose of the first rank in importance, there can be no question of the power of the State to levy taxes for the accomplishment of the purpose. The power of taxation exists for

every public purpose unless some constitutional prohibition, either Federal or State, has taken it away. I find no such prohibition. I confess my inability to understand the reasoning which finds it in that clause of the constitution which commands the legislature to levy an annual tax to defray the estimated expenses of the State. The power of taxation is one of the necessary attributes of sovereignty. To say that, because the constitution makers thought best to make a specific provision that taxes should be levied for certain purposes, they intended thereby to interdict taxation for all other purposes, is to my mind unthinkable. Besides, if afforestation and reforestation be public purposes, then the moneys spent in carrying them on are necessarily and properly expenses of the State and come within the constitutional command. The expenses of a State include the moneys which it spends in carrying out the public purposes which the legislative judgment directs to be carried out.

"Third, afforestation and reforestation of large areas are not 'works of internal improvement' within the meaning of the constitution . . . the term includes 'those things which ordinarily might, in human experience, be expected to be undertaken for profit or benefit to the property interests of private promoters, as distinguished from those other things which primarily, and preponderantly merely facilitate the essential functions of government.' . . .

"Now, I affirm that it is not to be expected in the light of human experience, in this land at least, that the establishment and conservation of great forest areas for the public good should be undertaken by private enterprise, and I also affirm my belief, as previously stated, that such work is preeminently a public work, and hence one of the essential functions of government. It has not been recognized as such until recently, perhaps, but that is merely because the conditions which make it such have only recently arisen and become acute. So in my judgment every act which is necessary to be done in successfully carrying on afforestation and reforestation, including the purchasing of the necessary lands, may properly be done by the State. My original opinion was that this might properly be done by the State. My original opinion was that this might properly include the erection of sawmills and the manufacture of lumber out of the timber which under the rules of scientific forestry ought to be cut, but I yielded my opinion on this point, and I stand by the concession."

In various ways the State had become possessed of about 358,000 acres, of which around 160,000 acres had been purchased as forest reserves at a total cost of somewhat over $548,000, and around 20,000 acres were Federal government grants for reforestation purchases. As a result of the court decision, on all the lands acquired by the State under the forestry laws, either by purchase or by tax deeds, the normal school fund has now secured a lien and they are to be managed as school fund lands, but the Conservation Commission, "having as a

primary object the production of school fund money, has the right to manage all the State lands." . . . "Therefore, it is possible for the State to hold the forest lands now possessed and to acquire other lands, provided such purchases are made to enhance the value of the trust. With the same object in view, it is possible to reforest portions of the so-called forest reserve." In a measure, however, these lands come under the jurisdiction of the Public Land Commissioners for administration, at least so far as sales are concerned and the investment of funds arising from these lands. The matter is more or less in a muddle. A revision of all the laws pertaining to the public domain is necessary and, indeed, has been prepared by the commission and is before the legislature.

Soon after this unfortunate collapse of the forest reserve policy—for we consider it so in spite of the hopeful attitude of the commission—a change in administration was enacted by abolishing the State Board of Forestry, which had been efficient, if run ashore. It does not, of course, appear in a public report what considerations, political or economic, led to the change. Seemingly, however, considerations of laudable economy led to the amalgamation into one State Conservation Commission of the State Park Board, the State Forestry Board, the Commission of Fisheries, Fish and Game Wardens, and the existing Conservation Commission. Thus with one fell swoop 22 non-salaried and six salaried commissioners made room for three salaried ones, one of whom, Mr. F. B. Moody, is a forester by profession.

The commission makes a special point in announcing that under their rule politics has been and will remain absolutely abolished.

> "Because of restrictions placed upon the activities of the old forestry board by the Supreme Court prior to the creation of this commission, the work on the forest reserves has been confined, chiefly, to that of protecting all State lands north of Town 33 from fire and trespass, the sale of dead, down, dying, and mature timber, the maintenance of two forest nurseries, the sale of planting stock therefrom, surveying and leasing islands and lake lots, and other work incident to the proper care and protection of the property."

The forester commissioner writes the forestry report himself; a short consideration of the extent, value, and use of woodlots, which in Wisconsin comprise over five million acres, and a chapter on the State forest nurseries, which, besides furnishing stock for the State's planting, furnishes stock at cost price to private owners, being furnished by C. L. Harrington. Nearly 1,000 acres of State lands are by

this time planted, and somewhat over 200,000 plants were furnished for private planting. We note that in order to encourage real forest planting no order of less than 100 trees is granted and for orders of less than 1,000 trees an extra charge of 50 cents is made; the price per thousand ranging between $2.50 and $5, the latter for four-year transplants—hardly good stock to handle.

The main discussion in the forestry part of the report is placed upon forest protection. The existing organization, under which town chairmen are made fire wardens and road superintendents assistant fire wardens, is criticized because fighting fires, rather than detection and prevention, is their duty. A real protective service, with lookout towers, telephones, and trails, is provided only on the sections which contain State lands, comprising 17 districts, aggregating some one and a quarter million acres. The cost on this area was 1 1/3 cents per acre in 1915. To give point to this discussion a special forest fire plan for an area comprising the headwaters of the Wisconsin and Chippeway Rivers, some 74 townships, is elaborated in all detail on 12 pages, in which the accumulated experience of fire fighting in other parts is fully utilized.

Since the change of administration to the new commission took place one year after the biennial period ending 1914, the first half of the period which the present report ought to cover was reported upon by the previous board. But the present commission has not seen fit to publish that report, a procedure which is, to say the least, strange from the administrative point of view of a great State. This omission might almost be construed as a reflection of the previous board and of its work, which it certainly does not deserve.

In a year, of course, the new commission could hardly have made any striking progress. The one notable project is that of extending the limits of close fire protection over another million acres, in co-operation with private owners and the Federal government.

B. E. F.

The Flora of Canada. By J. M. Macoun and M. O. Malte. Museum Bulletin No. 26, Geological Survey. Ottawa, Canada. 1917. Pp. 14.

In 14 pages it would be impossible to discuss a flora of nearly 5,000 species, distributed over more than three million square miles, in much detail, and one is tempted to ask what useful purpose could be served by such a wholesale treatment as the limited space allows. The principal, or we might say only, value lies in the enumeration

of species characteristic of the various biological zones into which the Dominion can be divided, and in this way aiding the botanist to orient himself.

There are ten such zones recognized, and under each the principal and characteristic tree, shrub, and herbaceous flora is enumerated. It should, perhaps, be noted that the differentiation into zones, which the authors adopt, is open to criticism, lacking in uniform biological basis, and in some cases calling for further subdivision.

Generally speaking, the Canadian plants may all be considered immigrants after the ice age subsided, with a small exception of endemic plants on the Coast Range. One striking feature in the distribution, explainable by the manner of the migration after the glacial period, is the occurrence of identical species in localities separated by hundreds and even thousands of miles of land, across which, under present conditions, migration is impossible. This distribution has especially reference to arctic and alpine species.

The *arctic, treeless zone,* the southern boundary of which towards the east dips very considerably, contains very few species of American origin, they are mostly closely related to European in the East and Asiatic in the West; in other words, the flora is circumpolar, composed almost exclusively of perennial plants, largely occurring in bunches or dense mats. A distinction is made between the tundra, as the more southern and physiologically wetter part, and the more northern, rocky, more or less dry part.

While the whole zone has characteristic woody plants of prostrate willows or shrubby birches (*nana* and *glandulosa*), on the tundra ericaceous species of Ledun, Rhododendron, Vaccinium, Arctostaphylos and Empetrum are most prominent.

The *sub-arctic forest zone,* a rolling country, as yet mainly unsettled, with numerous bogs and lakes, which in the East is bounded by the white and red pine northern limit, or roughly by a line from Anticosti to the south end of Lake Winnipeg, is a coniferous forest of mainly white and black spruce and banksian pine with aspen, balsam poplar, paper birch and larch and balsam fir. The prevalence of berry shrubs are its most striking characteristic. The bog flora, as well as the whole sub-arctic flora, is remarkably uniform, combining species of arctic and more southern distribution. Only a small water lily, *Castalia tetragona,* is found in the sub-arctic zone only.

The *hardwood forest zone* to the south of the sub-arctic comprises the more or less settled country and the commercial timber area in the

East, the home of the white and red pines, hemlock and cedar, besides the hardwoods. The underbrush of Amelanchier, Dirca, Rubus, Rhus, Viburnum as characteristic shrubs, is said to be generally scanty and becoming conspicuous only along the forest border. It should be added for the forester's benefit, that after logging operations the border becomes "border" with abundant shrubby growth, making regeneration difficult. Herbaceous plants are very luxuriant in spring, but the summer vegetation is rather inconspicuous except in moist and wet situations. This is the region of magnificent autumn colors, but the statement that such wealth of color is never met with in any other country is somewhat colored by patriotic enthusiasm.

A comparatively narrow strip along Lake Erie and the Niagara Peninsula belongs to an entirely different zone, the *Carolinian,* which exhibits an overflow of the rich hardwood flora from the United States, with cucumber, tulip, sycamore, sour gum, sassafras, flowering dogwood, papaw and mulberry, besides chestnut, hickories, oaks, and black walnut. At least 100 herbaceous species occur with these trees, which are found nowhere else in Canada.

The *prairie,* east of Winnipeg and south of the sub-arctic forest zone, is divided into three subzones or "steppes." The southeastern or first prairie steppe still shows some characteristic woody and other plants coming from the East, as, for instance, Tilia and Celtis and along rivers *Ulmus americana, Quercus macrocarpa, Populus balsamifera* and *tremuloides, Acer negundo,* and a great profusion of herbaceous plants. The second and third steppe are treeless, except on bluffs and hills with a flora specifically their own (poplar, oak, and pine); at the northern boundary species of the sub-arctic forest zone creeping in.

In the *Rocky Mountain foothills zone* a great number of prairie species reach a considerable altitude, while a number of sub-alpine forms descend practically to the prairie, hence here at the base of the foothills the flora is especially rich. In ascending the slopes, prairie forms are replaced by mountain species and the vegetation becomes more luxuriant in appearance, shrubs come in and finally we are again in the forest. Some 30 species of typical lower vegetation are enumerated.

The *Rocky Mountain proper* in their lower levels up to tree line is a forest zone of coniferous species: *Pinus albicaulis, murrayana, Pseudotsuga, Abies lasiocarpa,* with only a scanty herbaceous vegetation and a few shrubs, among which *Pachystima myrsinites, Rhododendron albiflorum, Menziesia ferruginea* are most characteristic.

The herbaceous flora, although scanty, is rich in species, some 5t being enumerated as typical.

Crossing the Rockies, we come into an entirely different world, biologically speaking, and into more varied and complicated conditions.

The *Selkirk Range,* really a high level plateau from which the peaks arise, in their forest composition show Pacific Coast influences, with *Thuya plicata, Pseudotsuga, Picea Engelmanni,* and the two western Tsugas. The shrub vegetation, however, is on the mountains proper very similar to that of the Rocky Mountains, and although much more luxuriant, not represented by many species. In the lower valleys, however, both shrub and herbaceous vegetation is of Pacific Coast species, luxuriantly developed, no marked difference from the coast flora being discoverable.

Although practically all the species found in the Selkirks are also found in the *Coast Range,* there are species added which are confined to the coast proper, some of them truly endemic, very local in distribution and found nowhere else in British Columbia; among them numerous species of Antennaria, Arnica, Senecio, Aster, Erigeron, Salal (*Gaultheria shallon*) and Devil's Club (*Fatsia horrida*) are two of the typical underbrush, and among trees Sitka spruce, Oregon alder, *Acer macrophyllum* and *circinatum, Rhamnus Purshiana.*

A special zone must be made of the southeastern part of *Vancouver Island,* where, due to a comparatively small precipitation, more or less xerophil conditions exist and members of the California flora are found, which occur nowhere else in Canada, such as *Quercus garryana,* and *Arbutus menziesii,* besides numerous herbaceous species.

Another special set of conditions and corresponding flora is found in the *Dry Belts of British Columbia,* strangely contrasting with other parts of the Province, due to scant precipitation and to soil nature. There are two floristic subdivisions to be made, the one characterized by the bunch grasses (especially *Agropyrum spicatum* and *Elymus condensatus,* more or less destitute of forest growth, and the more densely wooded division with *Pinus ponderosa* in parklike stands, which exhibits a goodly number of xerophil herbaceous and shrub vegetation. B. E. F.

Timbers of British North Borneo, Minor Forest Products and Jungle Produce. By F. W. Foxworthy, Ph.D. Bulletin No. 1 of the Department of Forestry, British North Borneo.

The Conservator of Forests, D. M. Matthews, formerly of the

Philippine Forest Service, has recently published a very interesting bulletin. The work is by the noted authority on Malayan timbers, Dr. F. W. Foxworthy, of the University of the Philippines, and in charge of the forest school of the Islands.

The forest department estimates that there are 2,000,000 acres of commercial forest within 20 miles of the coast of British North Borneo, that will average not less than 2,000 cubic feet of saw timber per acre. Valuation surveys of 1,700 acres of eastern coast forests show a stand of 2,600 cubic feet per acre. The dipterocarps, which furnish the bulk of the commercial timber of the Philippine Islands, are here also the important species. Dipterocarpus, Shorea, Parashorea, Hopea, Dryobalanops, Isoptera, are the genera of this family, yielding over 50 per cent of the stand.

Seriah (Shorea), Kruin (Dipterocarpus), Urat Mata (Parashorea), Selangan Batu (Shorea, Hopea, Isoptera), are the most abundant timbers of the portions of the tract examined. The heavier stands noted were in the Cowie Harbor region where they averaged over 3,000 cubic feet per acre. Hong Kong is the principal market for Bornean timbers, taking 90 per cent of the total export. British North Borneo exported, in 1915, 1,500,000 cubic feet, largely in the form of logs. Seriah (Shorea) and Billian (Eusideroxylon Zwageri) are the principal export timbers in normal years, with Kruin (Dipterocarpus) a close third.

Last year on account of the high freight rates, due to the war, the low-priced seriah was exported in rather small quantities and the high-priced billian showed a marked increase. Billian is a very heavy, hard, durable wood belonging to the family Lauraceae, and is the Malayan equivalent of greenheart of the same family from the north coast of South America. It is estimated that the 2 million acres of coast forest will yield 50 million cubic feet a year indefinitely, without destroying the forest. A market for Bornean timbers is being created in London; seriah has been introduced under the name of Borneo cedar.

The bulk of the first part of this report is a carefully compiled list of the timbers, arranged alphabetically under native names. The dipterocarps on account of their importance are discussed separately.

The list gives for each species, so far as is known, botanical name, color, hardness, weight per cubic foot, distribution, abundance, and uses. There are but few gaps in the list and it is a remarkable piece

of work, considering the short time the conservator has been employed, the small amount of funds available, and the difficulties of tropical forest explanation.

A very interesting table is also appended, giving the Borneo trade names of the timbers and their equivalents in the markets of the Philippine Islands, Singapore, Federated Malay States, and in other parts of Borneo. The second part of the report considers the various minor forest products of the island forests. Among those enumerated and described are rattans, cutch (mongrove tannin extract), edible birds' nests, gutta-percha, india rubber, damar, and camphor. The importance of these products to Borneo is shown by a table of exports for the last thirty years. The total export of jungle products for this period was approximately 8 million dollars and this does not include timber. The timbers exported during this period were valued at approximately 5 million dollars. This statement presents a very attractive side of tropical forest administration. The forester in these regions should be able to manage, protect, and develop his forests with the revenue derived from the minor products, these light valuable products permitting a long haul by canoe or on the backs of men or animals over forest trails. The distant ports of the forests can thus be brought under control long before the timbers can be profitably harvested.

The bulletin is an extremely interesting and creditable publication. We congratulate the author and the conservator on its appearance. It shows what a few well-trained men can do in a few years to bend the tropical jungle to man's service. The world will draw from the tropics, year by year, an ever-increasing amount of timber, both for ordinary construction and for ornamental purposes. That these forests are abundantly able to meet the demands of temperate wood users is shown by the following quotation from Dr. Foxworthy in this bulletin: "A popular opinion seems to obtain that the bulk of the forest is composed of timbers which are heavier than water. This is a very mistaken notion, as a little more than 50 per cent of the volume of standing timber is contained in trees whose logs will float when first cut." This statement will come as a surprise to many in the profession who have not followed closely recent investigations of tropical timbers.

H. M. Curran.

Yale Forest School.

Report of the Department of Forestry of the State of Pennsylvania for the Years 1914-15. Harrisburg, Pa. 1916. Pp. 247.

We have at various times expressed the belief that of all the States, Pennsylvania stands foremost in having really developed a business forest policy. Anyone who wishes to verify the basis for this belief can do so readily by perusing this biennial report. It is business from beginning to end. There is no merely educational or propagandist literature included. The only matter that lies outside the story of the State forest administration—and that perhaps not quite—is a brief account of the luncheon given as a well deserved testimonial to the veteran Dr. Rothrock, who has been mainly responsible for the successful origin and foundation of that administration.

With around one million acres of State forests as a background—to be sure, mostly cut-over lands—considerable business develops and keeps the staff of 68 foresters, each with a revir, and 85 forest rangers occupied. The detail of their activities is given in a sensible tabular form. The account of their work should be a stimulus for the State to expand the State forest policy, and without swerving, bring as fast as possible the remaining 7,000,000 acres of cut-over lands under State management, while they may still be had for a little over $2 per acre, as the latest purchases have cost.

The expenditures of this forest service have averaged in the two years for which the report stands around $325,000 per annum, while the receipts were only $28,550 (and since the organization, $104,000), which, by the way, are turned over to the State school fund. But, meanwhile, the properties have been improved by thinnings and plantings, and have been brought into orderly shape for management. The financial definition of forestry still stands: "Making present expenditures for the sake of a future increased revenue;" and the State must make up its mind that for quite a time to come it will have to make the investment without adequate return, but eventually with as excellent results as the German State forests are yielding: these have lately averaged from around 10 million acres over $3 net per year per acre, good, bad, and indifferent, and there is no reason why similar and even better results should not be experienced in Pennsylvania.

The bulk of the expenditures, around 40 per cent, goes to the field men; the overhead charges, as far as they can be segregated from the financial statement, are less than 5 per cent; forest fires still consume about 10 per cent of the expenditure, and the reported fire loss in the State is over $200,000; road and school taxes, 12 per cent, and the State

Forest Academy, with $10,000 per annum, is most economically managed on a little over 3 per cent.

However, the exigencies of a report to the legislature are satisfied with the brief statement of expenditures, the student of forest economy would welcome a closer analysis and classification of the lumped items which appear under Surveys, Labor, Incidentals. This is done in fullest detail under separate chapter headings.

There is a special report on the nursery work, from which we learn that the four large and 22 small nurseries produced over four million plants in 1915, worth over $10,000. Some of the plants used to be sold at cost, but a recent law permits the giving of seedlings free of charge to individuals for reforesting purposes. So far only a little over one hundred thousand have been so disposed, the State forests requiring the bulk of the production, some four million having been planted in 1915 and over 16.5 million since 1899. More than half the seedlings were of white pine and 30 per cent Norway spruce, but the prevalence of weevil and blister rust will no doubt reduce the growing of white pine.

A very detailed account is kept of all nursery operations under more than sixty subheadings, but only one nursery, Mont Alto, under Professor Retan, appears with a complete report and desirable detail.

This nursery contains nearly four million plants, half of them ready to ship. Various economies have reduced the average cost of 2-year seedlings in the bed by 70 cents under the best previous year to $1.19 per M, a figure "unheard of in this nursery." The cost of this nursery runs somewhat over $2,000, student labor being in part employed.

From another nursery, cost of producing stock is reported as $1.29 for 2-year-old white pine, $2.02 for 3-year, and $1.88 for 2-1-year transplants; $2.67 for 1-year red oak. A Pennsylvania transplant board is mentioned—we have seen no description of it—as reducing the transplant cost by 30 cents.

Prof. Retan comes to the conclusion that "fertilizers benefit the soil only temporarily at best; physical treatment reaches the root of the trouble and the roots of the plants," as explaining the remarkable result of the application of a surface cover of charcoal in plant production. Fertilizer experiments, carried on in several nurseries, with some twenty combinations of fertilizer, seem to support this finding.

Great stress is laid on water supply, especially in the first year, but also in the second year proper irrigation develops superior quality and weight.

An important experiment leads to the statement that "fall *sowing* proved a great success." The seedlings from fall sowing "are as large as average two-year seedlings. One hundred of them weigh twice as much as one hundred from the other beds." And 3,000 of these one-year-olds planted are reported as having "a year's start on all other plantations." "Their growth exceeds that of two-year-old seedlings in the nursery." We call, however, attention to the fact that Mont Alto has a semi-southern climate!

Fall *planting* in the forest is also experimentally practiced.

From the chapter on planting, we learn that so far nearly 9,000 acres in 815 plantations have been planted at a cost of a little less than $97,000 and as a little more than 16 million trees were planted, the average cost per acre was a little less than $11, and per M around $5.24, but the range lies between $6.74 and $22.65 per acre, and $1.49 and $7.27 per M. Of the total expenditure, 46 per cent goes for plants, about 75 per cent of which were white pine, some 25 other species being enumerated as used.

It is estimated that between 300,000 and 400,000 acres of the State forest will have to be artifically reforested, and that planted since direct seeding has not proved successful. The report suggests that 15,000 acres should be planted annually instead of the two to three thousand as at present. The necessity of making definite periodic planting plans instead of the haphazard planting hitherto practised is recognized.

Scrub oak lands have been experimented with, but so far without notable success. A few other experiments without definite issue are also mentioned.

Under the somewhat misplaced title of Silviculture and Mensuration—for the preceding chapters on nurseries and planting belong under Silviculture—we learn that systematic forest surveys have been inaugurated on eight forests, starting with topographic surveys. So far, 168,000 acres have been surveyed. Some of the forests are already subdivided into compartments, and compartment lines are to be cut to a width of 6 feet (hardly wide enough if to be kept open at all, not even for the avowed purpose of fire guards!). Concrete posts, costing in place 30 cents, are experimented with for demarkation. Age class maps, stand maps, and growth studies are to follow: a forest organization according to the best European models—the only rational procedure—is begun!

Besides the tabulation of fire losses and of timber cut in the State with its value, a few minor items are discussed, such as lightning,

which out of 1,984 trees stricken, set only 65 on fire, a note on telephone poles of glass, a visit by the Society of Eastern Foresters, and an obituary of one of the State foresters, accidentally shot, in which case the department was unsuccessful in bringing the culprit to justice, and a discussion of the circumstances lay bare the impotency of the law in Pennsylvania, which is also exhibited in other trespass cases in which the department appeared as litigant.

It is with great satisfaction that we have extracted all the essentials of this report, which has appeared to us the first of its kind in its completeness and business-like procedure. It gives evidence that forestry has "arrived" in Pennsylvania.

We recommend the perusal of this report to every State forester or forest commission, in order to see where they ought to be.

B. E. F.

RECENT PUBLICATIONS

Annual Progress Report upon State Forest Administration in South Australia for the Year 1915-16. By W. Gill. Woods and Forests Department. Adelaide. 1916. Pp. 13.

Biennial Report of the Forestry Commission for the Years 1915-16. State of New Hampshire. Concord, N. H. 1916. Pp. 177.

Building Code Revision in Reference to the Use of Wood. By W. Buehler. *Permanent Exhibits.* By H. S. Sackett. *The National Lumber Manufacturers' Association: What It has Done—What It Might Do.* News Letters Nos. 1, 2, 4, Trade Extension Department, National Lumber Manufacturers' Association. Chicago, Ill. 1916. Pp. 4, 2, 4.

Catalogue of the Plants of Jasper County, Missouri (Fernworts and Flowering Plants). By E. J. Palmer. Reprinted from Annals of the Missouri Botanical Garden. September, 1916. Pp. 345-401.

Commercial Woods of the Philippines: Their Preparation and Uses. By E. E. Schneider. Bulletin 14, Bureau of Forestry. Manila, P. I. 1916. Pp. 274.

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Volume III, Part 8 (Part XXVIII of the complete work). Sydney, N. S. W. 1916. Pp. 157-82. Pls. 116-9.

Directory of Lumber Dealers Stocking British Columbia Woods and Lumber Wholesalers Handling British Columbia Woods in Eastern Canada. Bulletin 20, British Columbia Government Forest Branch. Victoria, B. C. 1917. Pp. 11.

Forest Fires in the United States in 1915. By J. Girvin Peters. Circular 69, Office of the Secretary, Department of Agriculture. Washington, D. C. 1917. Pp. 6.

Heavy Timber Mill Construction Buildings. By C. E. Paul. Engineering Bulletin 2, Engineering Bureau, National Lumber Manufacturers' Association. Chicago, Ill. October, 1916 (second edition). Pp. 67.

Implement Sheds; Grain Storage Buildings; Poultry House Construction. By K. J. T. Ekblaw. *Dairy and General Purpose Barns.* By F. M. White. Farm Bulletins Nos. 1, 2, 5, 7. Trade Extension Department, National Lumber Manufacturers' Association. Chicago, Ill. 1916, 1917. Pp. 24, 20, 20, 40.

Investigations of the Rotting of Slash in Arkansas. By W. H. Long. Bulletin 496, U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry. Washington, D. C. 1917. Pp. 15.

Life History of the Codling Moth in the Pecos Valley, New Mexico. By A. L. Quaintance and E. W. Geyer. Bulletin 429, U. S. Department of Agriculture. Contribution from the Bureau of Entomology. Washington, D. C. 1917. Pp. 90.

A Lower Jurassic Flora from the Upper Matanuska Valley, Alaska. By F. H. Knowlton. Publication 2158, Proceedings of the United States National Museum. Washington, D. C. 1916. Pp. 451-60.

Lumbering in the Sugar and Yellow Pine Region of California. By S. Berry. Bulletin 440, U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1917. Pp. 99.

The Pine Blister Rust. Bulletin 120, Massachusetts Forestry Association; in cooperation with Bureau of Plant Industry, U. S. Department of Agriculture. (Reprint of major part of Bulletin 15, Conservation Commission of New York.) Boston, Mass. 1917. Pp. 15.

Poles Purchased, 1915. By A. M. McCreight. Bulletin 519, U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1917. Pp. 4.

Report of Director of the Botanic Gardens, Government Domains, and Centennial Park for 1915. Legislative Assembly, New South Wales. Sydney, N. S. W. 1916. Pp. 30.

Shade Trees: Characteristics, Adaptation, Diseases, and Cure. By G. E. Stone. Bulletin 170, Massachusetts Agricultural Experiment Station. Amherst, Mass. 1916. Pp. 123-264.

Sixth Biennial Report of the State Forester of the State of California. By G. M. Homans. Sacramento, Cal. 1916. Pp. 56.

State Forestry Laws: Connecticut, Ohio. U. S. Department of Agriculture. Contributions from the Forest Service. Washington, D. C. 1916. Pp. 12, 4.

True Mahogany. By C. D. Mell. Bulletin 474, U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1917. Pp. 24.

Western Yellow Pine in Oregon. By T. T. Munger. Bulletin 418, U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1917. Pp. 48.

Your Garage. By C. R. W. Edgcumbe. General Series, No. 52, Trade Extension Department, National Lumber Manufacturers' Association. Chicago, Ill. November, 1916. Pp. 16.

Commercial Woods of the Philippines: Their Preparation and Uses. By W. F. Sherfesee. Bureau of Forestry Bulletin No. 14. 1916.

A comprehensive work, written mainly from the point of view of the wood user. It embraces a general description of the status of the industry in the islands, discussions of the properties, uses, and distinguishing characteristics of the woods, and a detailed description of some 360 species.

Das Holz, seine Bearbeitung und seine Verwendung. By Von J. Grossman. B. G. Teubner. Leipzig. 1916. Pp. 113; 39 ill. Price 1.25 marks.

In contrast with German researches, which, as a rule, distinguish themselves because of their basic and comprehensive contents, there is seldom anything of value for Swedish forestry practice to be found in the smaller German forestry handbooks. In spite of this, the book mentioned above deserves to be mentioned and recommended, as it contains a valuable summary of the author's standard work "Gewerbekunde der Holzbearbeitung," which is noted for more thorough studies of the character and uses of wood. After a short review of the structure of the tree and the different technical qualities and defects of wood, the book continues with a well coordinated description of the harvesting, conversion, and storing of wood. Subsequent chapters

take up the seasoning, preservation, and reworking of wood. The author has compiled a very valuable summary of the characteristics, technical use, sources, and approximate prices of different forms in the world marts of 54 of the world's most important varieties of wood. The concluding chapter contains a discussion of the economical significance of trees to the nation (Germany). A statement of the value of the wood used yearly in the world is not made with sufficient accuracy. The value of the yearly production of wood in the European countries is fixed by the author as about 1.5 million marks.—Translation from Skogsvardsföreningens Tidskrift.

PERIODICAL LITERATURE

SILVICULTURE, PROTECTION, AND EXTENSION

Forest Type Classification

If there were not abundant literature and to spare on forest types to be found in preceding volumes of the Journal, we would be inclined to furnish a complete translation of A. Arnould's very clear article on this subject, introduced with the curious title: "The Forestry Idea in Foreign Countries." This title explains itself by the statement that forest types are not recognized in France, each stand being considered individually without ranging it into genus or class. Further on we are informed that in Russia the question of forest type classification is still under controversy, Prof. Morosow, of the Petrograd Institute being the champion of the use of types. This article is based upon one by a young Russian student of Morosow, Melder, on the forest types of Kurland, in which he develops the basis for type classification. Incidentally, we may add that in Germany the idea of forest types is an old story (see Gayer's *Waldbau,* chapters on *Bestandsformen* and *Bestandsarten*), but no precise and complete classification has been developed. The absence of such classification can perhaps be explained by the lack of need for it owing to the lack of great variety of conditions, such as our complicated forest forms present, and by the eradication of many natural types.

Menger and Arnould attempt—it is sometimes impossible to distinguish to whom of the two authors the statements should be credited —to find the basis for such a precise classification, which would be (1) in conformity with the laws of nature; (2) detailed so that all cases can be explained, hence to be based on as many different characteristic signs, internal and external, as possible, like a botanical classification; (3) based on obvious, easily recognizable, practical characters.

The nature of the soil is recognized as one characteristic and the most important factor in producing results; the second is the composition, but this must be looked at in relation to the soil, and if the composition is completely "non-concordant," *i. e.,* unfit for the soil (due to man's interference?), the nature of the latter must be considered as of most importance; a third characteristic is found in the living soil cover, which in limited cases allows judgment of the soil, but since it is not a function of the soil alone it must be used with cir-

cumspection. A fourth characteristic is the method of character of regeneration, which Morosow accepts as an important criterion, but Arnould rejects because it is largely due to accidental influences and does not belong into a "natural classification," just as in entomology the habits of the insects do not serve as basis of classification.

A few examples are given showing that reliance on the character of the regeneration may lead to a misrepresentation of facts. A scientific classification, the author contends, must be established outside of considerations of management, must be in conformity with natural laws determined by readily distinguishable characters and have as basis the soil, all other distinguishing characters being of secondary importance.

The author realizes that it is difficult to judge the quality of the soil. This, one would think, can be done most readily by recognizing difference in results as represented by the stands, but the same results may be effected by different conditions of soil. Hence the need of these other characteristics, as the composition, the living soil cover, etc., are added to facilitate the judgment of soil quality.

The author also recognizes that the size of the area to which the type classification extends will influence the classification, and makes a distinction between permanent and temporary types, due to man's influence, fire, etc.

A page is devoted to the discussion of density. It is shown that whatever theoretically the definition of density, the practical determination rests entirely on three personal notions as regards number of specimens, size of crowns and character of the composition, thus "we obtain a subjectivity of the third degree and to speak plainly, we obtain nothing at all." It is necessary to find an objective method which takes into consideration only the spacing of the crowns independent of the composition, age and other cultural conditions of the stand. He solves this problem by calling density 1 when the crowns touch; again it will not be difficult to recognize density .5, *i. e.,* a spacing which would allow interposition between the existing crowns of the same number of crowns, and "with these two limits it will be easy to determine exactly the intermediate densities." (! ?)

In conclusion it is suggested that the fauna of the stand should be utilized to characterize it, giving lists of those animals, insects, etc., which are more or less fixed tenants of the condition in which the stand finds itself.

L'idée forestière à l'étranger. Les types de peuplement; leur classification. Revue des Eaux et Forêts, April, 1917, pp. 97–106.

Form Classes in Pine

In a comprehensive study L. Mattson gives the results of volume studies made by the Swedish Forest Experiment Institute in Hälsingland in fully stocked stands of *Pinus sylvestris lapponica* of ages varying from 79 to 115 years. Mattson states that the usual system of obtaining growth data in Sweden is by means of felled sample trees. He, however, prefers long-time measurements on permanent sample plots. His studies are designed to give some information on the relative accuracy of the different methods of measurements in fully stocked normal stands of pine, and were largely carried on in three sample plots.

The assertion is made that the "form factor" as a method of obtaining data is influenced by too many variables, such as density of stocking, soil and site, etc., and that the increasing use of the "form quotient" is a marked step forward, though he brands Schiffel's and Maas' methods as defective. Mattson's argument is that as the d. m. h. is an arbitrarily fixed point varying with respect to the d. b. h. in trees of different heights, the form quotient will vary greatly with trees of identical form but of different height, and cites as an illustration the fact that in trees nine feet high the coincidence of the d. m. h. and the d. b. h. will give an utterly absurd form quotient. The Tor Jonson "absolute form quotient," which disregards the portion of the trunk below the d. b. h., so that the d. m. h. is at the middle of the stem *above* this point, is preferred as giving much more consistent results even though it also is mathematically not entirely correct.

For different form classes with unlike absolute form quotients, Jonson has prepared taper tables calculated by means of Höjer's trunk curve equation. In determining the form class of standing trees, Jonson does not favor the Schiffel method based on the crown and trunk relationship, but has deduced a "form period" method based on Metzger's theoretical comparison between a tree and a "cubical" paraboloid, which consists in determining the point in the stem where the wind acting upon the crown produces the greatest bending moment.

In the course of the investigation an incidental study of the relation of the diameter at different heights and the thickness of the bark was made. Measurements on standing trees were made with calipers, hypsometers, and Löf's extension caliper, by means of which the diameters of the trees at a point six meters from the ground were readily and accurately obtained.

Detailed tables and curves graphically illustrating the results of

the measurements are given. Mattson arrives at the following conclusions: (1) The determination of the form class by means of the diameter quotient is quite positive. (2) The actual form class is independent of the d. b. h., and if the average form class for the stand is determined, sufficiently accurate results will be obtained. (3) The average form class of a stand increases with age. (4) Variations in the determination of the form period of trees on three sample plots by three persons working at different times were less than 2½ per cent, indicating that the use of this method in pine stands is very practicable. (5) The use of the form period method is limited to the determination of the *average* form class, and is not applicable to individual trees.

B. L. G.

Skogsvårdsföreningens Tidskrift, February, 1917, pp. 201–36.

Experiment Station of Sweden

The Forest Division of the Swedish Forest Experiment Station during the year 1916 occupied itself with studies in silviculture, silvics, mensuration, and applied entomology. The germinating properties of *Pinus sylvestris lapponica* seed were intensively studied on ten sample plots, and studies to determine the best time of the year for the planting of seed in Norrland progressed with the conclusion of observations on three sample plots. More areas are taken under observation; studies of the effect of thinnings on six sample plots were continued, and thirty-three new sample plots were established; 8,021 stem analyses of felled sample trees were made during the year; silvicultural control of wood borers occupied much attention; progress was made in researches on the nitrification of humus, and new and accurate methods for the determination of the percentage of humus in forest soils, as well as the limonite (iron) content, were devised by members of the investigative staff. The fungus diseases of northern pine were also studied. The entomological division conducted a rather extended study of wood borers and measuring worms and a promising attempt was made to propagate parasites of the nun moth. The Division for Reforestation Experiments in Norrland established 51 new permanent sample plots, and summarized the results of observations on previously established sample plots.

B. L. G.

Skogsvårdsföreningens Tidskrift, February, 1917.

Weeds and Tree Growth

That grass and weeds generally have a deleterious effect on tree growth is axiomatic, but the degree of damage has rarely been subjected to experimental ascertainment. Professor Somerville reports on his own and some others' experiments in this direction. The effect of surface conditions, especially of a grass cover, even on old trees which send their roots into the depths is explained by the fact that the trees form a large amount of fibrous roots near the surface, especially humus soils. Different species are more or less affected; generally speaking, conifers less than hardwoods, but such genera as Taxodium, Sequoia, Thuya, and Cupressus less than Pinus. The interesting results of an exhaustive test on fruit trees during 16 years on the Duke of Bedford's experimental fruit farm at Woburn are given. The injurious effect of grass was proved not to be due to interference with the circulation of air in the soil or to the amount of carbonic acid gas, or to soil temperature, or to food supply, or to physical condition, or to the microflora of the soil, but to a toxic substance elaborated by the grass.

Another experiment, by Armstrong and Pratt, in 1912, carried on with forest trees and various weeds, as well as grass, is of interest in showing that the effect was distinct at the end of the first season in the stunted and prematurely shed foliage, shorter shoots than on bare ground; stinging nettle and creeping buttercup reducing normal growth to one half, grass to one third, or one fourth, or even one eighth, different species of grass having different effect; couch-rye grass and fiorin proving most pernicious.

Professor Somerville's experiments confined themselves to 120 3-year-old ash trees, planted in 1910, half of them kept free from weeds, the other half sown with a mixture of grass seeds. After two seasons the height of the trees on the first area was nearly 50 per cent greater than that of the grassed trees, in the first year this difference being 31 per cent, in the second year 109 per cent; and the root system on the ungrassed area much larger.

A second experiment with 30 ash trees, planted in ten sets of pots, each sowed with a different seed, excepting two bare check pot series, showed very variable results, which are illustrated in two plates. While the height growth showed but little variation after one season (although superior in bare pots), the character of the plants varied considerably, all except the one sown to white clover showing feeble development of foliage; lucern, gorse, and common broom, however,

not having the beneficial effect of the clover; the broom, indeed, having the most restrictive effect on height growth. Weekly clipping had a beneficial effect. Since all pots were freely watered, it would appear that the result can hardly be due to deficient soil moisture and supports the theory of toxic substances being excreted by the weeds.

Effects of Grass on the Growth of Young Ash Trees. Quarterly Journal of Forestry, July, 1916, pp. 212–18.

MENSURATION, FINANCE, AND MANAGEMENT

Indemnity for War Damage in France

An interesting discussion by Demorlaine considers a law now before the Senate of France, regarding indemnities for damage sustained by property owners in the war zone. While the law does not particularize forest properties, the author expects that such are naturally included. One clause of the law requires the application of the indemnity to a restitution of the destroyed property. Protests against this condition have been made by economists because it interferes with personal rights and liberty. But the author argues that in the case of forest properties, on account of the special nature of forest cover in its influence on cultural conditions, the clause should be upheld, that is to say reforestation is a necessity. The fact that already forest properties are regarded as special cases forms one of his arguments. He recognizes, however, the fact that this requirement may occasion hardships, as for instance, when an owner of timberland, who had lived on the returns from it, would have to remain without income because the indemnity would have to be applied to the re-creation of his capital without returns for a long time. Often the indemnity might not be sufficient to cover the cost of reforestation. The difficulties of handling the shell-sown lands are also mentioned.

The way out of the dilemma the author sees in an alternative clause providing for expropriation at the choice of the owner. In this way, the State forests may be desirably increased.

Incidentally, the interesting suggestion is made that the indemnity to be paid by the vanquished might in part at least be paid in kind, when wood materials and manufactures might be imported from Germany instead of money indemnity.

Les dommages de guerrs aux forêts. Revue des Eaux et Forêts, April, 1917, pp. 107–12.

FOREST DESCRIPTION

Backwoods of Switzerland

From the canton of Valais, located in southeastern Switzerland, an anonymous writer describes conditions which remind one of conditions as they exist, or did exist, "behind the blue ridge." Under the title "*Valeurs Inemployées*" (unused values) the author describes the backwoods in the higher altitudes, which have remained unexploited, or hardly exploited, to the present time, more or less in virgin condition. The stands mainly of larch and spruce, pure or mixed, offer the various aspects which a virgin forest would offer. Here one meets dense and relatively uniform, even-aged stands, the result of seeding after a fire, a windfall, an avalanche; there a selection forest type is encountered, the result of irregular cuttings, or of natural causes, rot, windfall, variation of soil and topography; stands of the very best quantitative and qualitative production in perfect conservation; trees 4 to 6 feet in diameter, of extraordinary height and of a remarkable form factor.

The reason for the persistence of these valuable woods is in part due to physical causes, namely inaccessibility due to topography, hence difficulty of transportation, but mainly to economic causes, more or less bound up with the character and condition of the population. First of all, there is a lack of population (only 64 to the square mile) and of labor, and a jealousy between neighboring communities which excludes mutual help. Moreover, there is ignorance of anything like lumbering or lumber trade beyond supplying private needs, and prejudice against the only way in which exploitation would be practicable, namely, logging on a scale which would enable the construction of means of transportation. The population is rural, engaged in various farm work, and with the scarcity of labor and short growing season the farm work can hardly be got through in time before the winter arrives, leaving no time for other work, while the tending of the stock and production of manure, and the cutting of fuelwood consume the winter time of short days and heavy snowfalls.

How is the situation to be remedied, and how can these valuable forests be utilized now when, due to the war, every resource needs to be drawn upon, when more than ten million dollars worth of importation must be replaced by home production?

The author proposes that the forest administration take a hand in it, by providing means of transportation, organizing the wood sales

on commercial principles, and, perhaps, organizing a corps of loggers, so as to be able to inaugurate large enough operations, advancing the funds upon an exact cruise of the communal property as basis for a mortgage. But the author realizes the difficulty of his plan in view of the stubborn attitude of the population towards any innovation.

Valeurs inemployées. Journal forestier Suisse, March, April, 1917, pp. 41–46.

UTILIZATION, MARKET, AND TECHNOLOGY

Logging with Motors

Although motor trucks and tractors have been used in logging operations on the Pacific Coast, to a limited extent in the past, such use received a great impetus last year, due to the high price of steel and railroad equipment.

The motor truck finds its chief field with the small loggers; it is also a possibility for large loggers in cutting small isolated areas.

One logger reports that on a 7.8-mile haul his motor truck averaged six trips daily, hauling from 3,000 to 5,000 feet log scales per trip.

A logger on the North Pacific Coast, using a 10-ton Knox logging tractor with a trailer, states that the machine makes from four to five round trips daily for distances from 2 to 7 miles, and hauls from 15,000 to 40,000 feet of logs daily, depending on the length of haul and the condition of road.

On a 7-mile haul another logger makes four round trips daily, averaging 4,000 feet per trip.

A firm in Washington uses two tractors for hauling logs to the sawmill, a distance of 3 miles, during the day time, and employs one tractor at night to haul lumber to the railroad, 6 miles distant.

From the above performances, it would appear that the logging tractor is rapidly gaining a place in the lumber industry. It is certain to prove a boon to the small logger.

American Lumberman, April 7, 1917, p. 66.

Logging Costs Advance

In an unsigned article the author analyzes the cost of producing spruce lumber in New Brunswick and finds that spruce logs at the mill pond have cost $13.35 and the mill product $19.65, being about $2 dearer than in 1916. Wages were running from $35 to $40 per month as against $28 to $32 in the previous year, and

labor less effective. Provisions, with the exception of hay, advanced from 1915 to 1916 30 to 50 per cent, and pork, which was $24.50 per barrel in 1915, had in 1916 advanced over 60 per cent to $40.50. The costs are made up of stumpage and ground rent, cruising, fire ranging, surveys, and interest, which amount to $3.25; woods operation, $7.60; driving, rafting, etc., $2.50; sawing, with upkeep and interest, $3.60; piling, insurance and handling, 90 cents; office, interest and selling cost, $1; total, $18.85. To this another 80 cents per thousand is to be added because the New Brunswick government log survey, which includes culls, cannot be sawed out of the logs.

Canada Lumberman, April 1, 1917, p. 21.

Dressing for Wounds

As a matter of incidental interest, the results of a series of experiments with different substances for covering pruning wounds, by G. H. Howe, may be related. White lead, white zinc, yellow ochre, coal tar, shellac, and carbolineum (avenarius) were employed on pruning wounds of various sizes and age of apple and peach trees, with some wounds untreated for check. The observations were made in the two seasons following the treatment. In all cases the untreated wounds healed more rapidly than the protected ones. Shellac caused the least injury to the cambium, but had least adhesive power. Carbolineum and ochre were very injurious, the white paints the least so; especially white lead was most efficacious; tar is evaporated too easily. Nothing is gained by waiting with the application.

In peach trees, and presumably other stone fruit, all substances produce damage.

The total result is inimical to the use of dressings, but the author admits that for a longer period of observation infection of fungi, which was not observed in the two seasons, might occur and change the finding.

Bulletin International Institute of Agriculture. Reprinted in The Indian Forester, February, 1917, pp. 105–6.

PERSONAL

Carlile P. Winslow has been appointed director of the Forest Products Laboratory at Madison, Wis., to succeed Howard F. Weiss, resigned.

Forest Assistant Wyman, who looked after the meteorological records, insect control, and the herbarium at the Fort Valley Experiment Station, was transferred to Missoula, Montana, March 22, where he takes charge of insect control work for District 1.

Numerous changes have been made in personnel in the Southwestern District recently, especially as regards deputy supervisors. Deputy Supervisor James H. Sizer has been transferred from the Apache to the Tonto Forest; Fred Arthur from the Manzano to the Gila Forest; Robert Munro from the Gila to the Datil Forest; Forest Examiner Wales from the Datil to the Manzano; Deputy E. G. Miller from the Datil to supervisor of the Prescott; Ira T. Yarnall from the Santa Fe to the Coconino Forest; and L. B. Maxwell, promoted from grazing assistant on the Coconino to deputy supervisor on this Forest.

Supervisor Jno. D. Guthrie is taking an active part in the formation and training of the Flagstaff Home Guards. He is adjutant-captain of the troop, of which former Supervisor Fred Breen is colonel and commanding officer. Many of the local forest officers are members of the organization.

Prof. A. B. Recknagel, of the Department of Forestry at Cornell University, has been granted a year's leave of absence from his university duties in order to accept the position of Forester to the Empire State Forest Products Association. He will take up his new duties on the first of July, and will establish headquarters for the association at Albany. The work which Professor Recknagel will undertake marks a new departure in the practice of forestry by private owners in the United States. The Empire State Forest Products Association is made up of prominent lumbermen and paper manufacturers in New York. The members of the association own upwards of one million two hundred thousand acres of timberland in the State. The association at its last annual meeting decided to establish a

rational and constructive system of forestry for the handling of these lands.

Prof. Ralph C. Bryant will give the course in forest utilization—logging and milling—at Cornell this summer, vice Professor Recknagel, who will be on leave of absence. Bryant is a Cornell alumnus, and his presence at the Cornell summer camp in the Adirondacks will prove an inspiration to the students.

C. A. Lyford and H. E. Brinckerhoff announce, under date of April 10, that they have formed a partnership, under the name of Clark & Lyford, for the practice of forest engineering. They will act as eastern agents for Clark & Lyford, Ltd., of Vancouver. Their office is at 15 East Fortieth Street, New York.

Dr. Richard H. Boerker resigned from the Forest Service in order to devote the major part of his time to research in forest and plant ecology. He is developing a 300-acre experiment station in the Catskill Mountains, where many ecological studies are already under way. His city address is No. 24 Sunnyside Court, Brooklyn, N. Y.

1. *Northeastern United States and Eastern Canada*

Hugh P. Baker left Syracuse on April 4 for a sabbatical year. Until the middle of August he will be studying methods of administration and instruction in western forestry schools and colleges. Then he will travel through Japan, China, Java, India, and probably the South Sea Islands, studying economic, commercial, industrial, and forestry conditions, vegetation, and transportation as it applies to forestry products.

J. H. White of the forestry faculty of the University of Toronto has been appointed Assistant Provincial Forester for the Province of Ontario under Zavitz, but will, in addition, continue his university work for the present.

Dr. Harry P. Brown, who specialized in forest botany and wood technology in Cornell and who was with the U. S. Forest Service for a time as zylotomist, has been advanced from the position of assistant professor of forest botany in the New York State College of Forestry at Syracuse University to full professor of forest technology in charge of the department of forest technology. This department will have

charge of the educational and investigative work in dendrology and wood technology.

Ernest G. Dudley, who has an A. B. degree from Leland Stanford, Jr., University, and who took one year at the Yale Forest School, has just resigned his position as forest examiner in District 5 to take the position of assistant professor of forest extension at the New York State College of Forestry at Syracuse University. He has recently been in charge of the U. S. Forest Service exhibit at the Panama-California Exposition in San Diego. As Mr. Dudley was brought up in Connecticut and had very considerable experience in woodlot work before going West, he comes into the work in New York especially well qualified.

At the meeting of the Yale Corporation on March 19, Assistant Professors R. C. Hawley and S. J. Record were elected to full professorships.

Barrington Moore is associate curator of woods and forestry at the American Museum of Natural History in New York.

The Department of Forestry at Cornell has already (April 15) lost the following professional students through enlistment in the land and naval forces of the United States or in the American Ambulance Field Service in France: *Seniors:* J. S. Everitt, E. Frey, S. C. Garman, H. O. Johnson, G. S. Kephart, E. I. Kilbourne, A. A. Manchester, E. Myers, R. E. Perry, Jr., L. R. Skinner, S. H. Sisson, E. I. Tinkham, R. A. Wheeler—13 out of a class of 20. *Juniors:* I. H. Bernhardt, W. D. Comings, C. W. Comstock, B. D. Dain, D. K. Hendee, W. B. McGrew, A. C. Shaw—7 out of a class of 25. *Sophomores:* A. A. Baker, F. E. Forbes, A. D. Honeywell, E. C. Hunt, W. W. Jeffrey, T. Roberts and W. E. Wright—7 out of a class of 25. *Freshmen:* G. B. Moffett, Walker Smith—2 out of a class of 29. Total, 29 out of 99. It is desired to secure similar lists from the other schools in order that the very active participation in national defense these neophytes in forestry may be on record. Not to be outdone by their students, the Cornell faculty has organized a company which meets for weekly drill under the direction of regular army officers. Bentley, Hosmer, Recknagel, and Spring are members of this company.

G. Harris Collingwood has been on leave of absence from Cornell this spring and is doing graduate work at the University of Michigan for an M. A. degree in June.

J. J. Levinson has severed his connection with the Park Department of New York City and is now consulting landscape forester at Sea Cliff, L. I.

J. S. Kaplan, M. F., Yale Forest School, 1911, has been appointed to succeed Levison as forester of the N. Y. City Park Department.

Nelson C. Brown, professor of forest utilization, Syracuse University, has been granted leave of absence for a year. He has been appointed one of the foreign trade commissioners to study the possibilities of foreign lumber markets and will probably leave for England soon.

Chapman and Woolsey are contemplating the publication, this fall, of "American Forest Regulation." "It will be," writes one of the authors, "something like Roth's 'Regulation,' but more Americanized, perhaps."

2. *Southern United States*

Frederick H. Miller, a newly fledged M. F., from Cornell, is now assistant to the State Forester of Texas.

G. Morris Taylor, a recent M. F. from Cornell, is with the American Creosoting Company at Russell, Kentucky.

John Foley has been elected president of the American Wood Preservers' Association.

L. Judson has left the Consolidation Coal Company at Jenkins, Ky., and is now with the Northeastern Forestry Company at Cheshire, Conn.

R. V. Myers (Biltmore) has left the Consolidation Coal Company, and is now cruising in Canada for J. W. Sewall.

3. *Central United States*

Howard F. Weiss has resigned from the directorship of the Forest Products Laboratory at Madison, Wis., and accepted a position with the Burgess Company of that city.

O. L. Sponsler, of the Michigan forestry faculty, has resigned, effective with the close of the college year, to enter private forestry work.

Filibert Roth has been elected president of the Society of American Foresters with Wm. T. Cox as vice-president.

W. I. Gibson leaves the Forestry Department of Michigan Agricultural College in June to take up private work in East Lansing.

4. *Northern Rockies*

E. C. Rogers, forest examiner in charge of the Savenac Nursery, has been elected to the scientific honorary society of Sigma Xi. Rogers expects to get his M. F. degree from Cornell this June.

Elers Koch has been elected chairman of the Missoula section of the Society of American Foresters.

5. *Southwest, Including Mexico, Central and South America*

Thomas P. Reid, scaler on the Tusayan National Forest, resigned on March 3, to become forester with the International Lumber Company of Minneapolis.

A. O. Waha, assistant district forester at Albuquerque, is now in the Washington office of the Forest Service for an extended detail.

Lenthall Wyman, forest assistant at the Fort Valley Experiment Station, at Flagstaff, Arizona, was made a forest examiner in March, has been transferred to Missoula, Mont., and assigned to forest insect work.

F. P. Porcher, Biltmore 1904, who has been stationed at the Fort Valley Experiment Station for the past year, has been transferred to the Crook Forest at Safford, Arizona.

Director G. A. Pearson of the Fort Valley Forest Experiment Station has been in Washington on special detail.

T. S. Woolsey, Jr., has completed his work at Yale and is now in Dawson, Georgia, where he will remain until May.

6. *Pacific Coast, Including Western Canada*

Chas. J. Musante, Biltmore 1912, is on the Tule River Indian Reservation (Porterville, Cal.), as forest ranger in the U. S. Indian Service.

E. P. Meinecke, forest pathologist, connected with the district office of the Forest Service at San Francisco, was a welcome visitor at Cornell on March 19. Dr. Meinecke spoke before the forestry students on "The Forest and Disease."

7. *Hawaii, the Philippines, and the Orient*

Forsythe Sherfesee, adviser in forestry to the Chinese Government, resigned from the Philippine Service on December 1. On January 27, Mr. Fisher of that service was appointed director in Mr. Sherfesee's place.

Oliver H. Bishop has left the Philippine Service and is in the employ of the United States Rubber Company at Kisaran, Sumatra.

Louis R. Stadtmiller is now in Shanghai with the China Import and Export Lumber Company.

NOTES AND COMMENTS

With the summer season at the door, we are called upon to reflect on the benefits which the policy of National Forests as recreation grounds, so wisely administered by Mr. Graves, has bestowed, and will bestow, upon many thousands of our citizens. The Forest Service is to be congratulated on the broad attitude it has taken in this respect, in seeing that not only direct material, and generally economic, interests may be subserved by the Forests, but that, without interfering with their economic usefulness they can be properly utilized for esthetic and health purposes.

The fact that this can be done and is recognized and realized by the Forest Service needs to be strongly emphasized in order to check rationally the movement which has been gathering momentum for some time, of creating National Parks—luxury forests—which serve only one purpose.

We have no quarrel with the existing National Parks; we can afford the economic waste that might be involved in a park management, such as we have become accustomed to in the Adirondack Park. But in these days, when the conservation of natural resources has become almost an obsession of the nation, it is as well to realize that the park or recreation value can be secured without sacrificing the material value. That this is so has been amply proved in Germany, where every National Forest is also a playground—with restrictions, to be sure, which are forced by the density of population.

To those who are wedded to the park idea we recommend Mr. Graves' convincing article in American Forestry for March, 1917, giving some details of the development of National Forests on the recreation line, which shows them in some respects superior to parks. Some 25,000 miles of trails and 3,000 miles of roads, which are built in the first place for economic purposes and fire protection, make these playgrounds accessible to the one and a half million persons (other estimators make it 2,000,000), who, according to Mr. Graves' estimate, in one year visited them. Nearly 700,000 visitors were estimated as having used the National Forests for recreation in Colorado alone. And this is only a beginning, which under the wise policy of the Forest Service in developing accommodations systematically is bound to multiply enormously. We need not add that fish and game preservation, or rather increase, forms also part of the all-round utilization policy.

According to Circular No. 69 of the U. S. Department of Agriculture, in 1915 some 40,000 fires burned over about 6,000,000 acres, or 1.1 per cent of the total forest area, causing a damage of $7,000,000, not counting loss of young growth, soil deterioration, and floods. Twenty-six per cent of the number were of unknown origin. It is interesting to note the difference of known causes east and west of the Great Plains. In the West over 26 per cent are accredited to lightning, the most frequent cause, while railroads were the most frequent cause in the East (20.7 per cent), closely followed by brush burning (19.1 per cent). Campers (18.2 per cent) and incendiary (12 per cent) are the next most frequent in the West, which in the East are responsible for only 6.2 and 5.5 per cent, respectively. The loss in the National Forests is estimated at $353,389 on about 280,000 acres. The expenditures of the Federal and State governments in fire control for the year amounted to $2,739,000, over two million of which were spent by the Federal government, and $420,000 by private protective associations.

There promises to be a very extensive revival of wooden ship-building in all parts of the country to meet quickly the pressure for more bottoms in which to handle freight. Wooden vessels are favored over steel because of the great difficulty in getting steel and because of the greater speed and lower cost of construction of wooden vessels. The type preferred appears to be vessels not to exceed 285 feet in length, 46.5 foot beam, 26 foot depth, and 3,600 tons dead weight. Vessels larger than this require expensive reinforcement. The vessels will largely be sail-rigged, with a maximum auxiliary power of from 1,200 to 1,500 horsepower, provided by Diesel, or semi-Diesel, engines. Such vessels would have a steaming radius of about 10,000 miles. Their cost is estimated at about $100 per ton complete. Lumbermen are greatly interested in the development of wooden ship-building plans, since each vessel will require more than one million feet of lumber in its construction, and hence a large market will be created for ship-building timber. In discussing the suitability of Douglas fir for ship-building purposes, one large operator on the Pacific Coast has recently stated that "in log cut for ship timbers, we find that an average of 30 per cent is available for this purpose, sometimes, however, running up to 50 and 60 per cent." Large numbers of such vessels are now in course of construction on the Pacific Coast, Gulf Coast, and Atlantic Coast. It is probable that a large part of the 50

million dollars at the disposal of the shipping board will be spent in building wooden ships.

Of the many National Park bills, only one, a meritorious one, was passed by Congress, namely, that creating the Mount McKinley National Park in Alaska, which sets aside the highest peak in America. The Grand Canyon National Park bill failed with the rest, but a decision by the court of appeals of the District of Columbia, after several years of litigation, has established the right of the Secretary of the Interior to disallow mining claims in the canyon, which in 1908 was declared a National Monument. The decision secures the absolute control of the canyon, without its being made a National Park.

The U. S. Treasury Department has recently rendered a decision, confirming an earlier finding, that Japanese oak lumber is dutiable as a cabinet wood. Japanese oak first made its appearance on the Pacific Coast about 1904, and its use so increased that until the lack of vessels prevented its importation, it represented approximately 90 per cent of all the oak used on the Pacific Coast. While much of the earlier shipments were in the form of hewed logs, there later developed a trade in kiln-dried, tongued-and-grooved, end-matched, hollow-backed flooring. The importers are fighting this decision, since the duty on lumber imported since the decision was first rendered is about $85,000. The case will be appealed to the board of general appraisers of Los Angeles and will be passed upon some time during the month of May.—Timberman, April, 1917.

The Loup Division and the Halsey Nursery of the Nebraska National Forest have been renamed in honor of the late Dr. Charles E. Bessey, to express appreciation for his work in securing these Federal developments. A similar honor is to be done the late J. Sterling Morton, by naming the Niobrara Division after him.

An addition of approximately 50,000 acres was made to the Whitman National Forest, Oregon, by act of Congress. The lands consisted in part of cancelled fraudulent entries and cut-over lands. The act also provides for exchange of Government timber in the Whitman Forest for private holdings.

The National Forest Reservation Commission has authorized additional purchases of 11,116 acres in the White Mountains, and 21,150

acres in the Appalachians, the largest purchase of 13,000 acres being made in Alabama.

A new project has been undertaken by the Fort Valley Experiment Station, known as the study of forest types, the aim of which is to determine the site factors limiting the distribution of tree species as well as those controlling reproduction and development within a given forest type. It will aim to solve fundamental problems and especial attention will be paid to the factors influencing the reproduction of western yellow pine. The project will include the study of types from the desert to timber line on the San Francisco Mountains, elevation 12,611 feet. In all, about eight stations will be established.

A series of illustrated talks has been arranged to be given by forest officers of the Southwestern District next winter at the Northern Arizona Normal School at Flagstaff. These talks will be given in connection with a course already inaugurated there on conservation of natural resources.

According to Bulletin No. 519 of the U. S. Department of Agriculture, a very complete canvass develops the fact that over 4 million telegraph and telephone poles were purchased in 1915, 25 per cent above the figures for 1907, and 16 per cent above that for 1911. Cedar furnishes still by far the largest number, namely, over 2½ million, with chestnut, pine, oak, cypress, and all other in sequence. The increase in pole consumption is due to railroad and power development, while telegraph and telephone companies used 30 per cent less poles than in 1911. Preservative processes are being used more and more by brush or open-tank treatment, creosote oil (11 pounds to the cubic feet) being the most frequently used.

The newsprint paper situation, which has become acute in the United States, where it has led to a number of indictments of manufacturers charged with constraining the trade and infringing the Sherman anti-trust law, has assumed a similar development in Canada by the appointment of a commissioner, who is to investigate the situation, and especially the cost of production, prices, etc. At present, the Canadian manufacturers have a voluntary agreement with the Canadian consumers to furnish newsprint paper at a set price at mills, which, of course, does not have any bearing on export prices.

The State Forestation Commission of Nebraska, inaugurated in 1913 to consider the practicability of reforesting the sand hills region, has drafted four bills for legislative action, one creating a permanent Forestry Commission; one for relocation of school lands on National Forests for the purpose of consolidation; and two having in view the establishment of municipal forests. The proposition of the Forest Service to abandon parts of the Federal reserves in the sand hills has been given up and appropriations for the extension of the planting up of these hills were secured through the efforts of the commission.

The summer meeting of the Association of Eastern Foresters will be held on July 11 to 13 as the guests of the Delaware and Hudson Railroad on its properties near Plattsburg, N. Y. The tentative program includes an inspection of the plantations of the D. & H. Railroad, a visit to Dannemora Prison, Plattsburg Training Camp, and to the Bluff Point Railroad nursery.

For the first time since 1904 the Yale Forest School will omit its usual summer camp at Milford, Pa., owing to war-time conditions.

An interesting comparison between State and casualty insurance for workmen has been made by the Oregon Industrial Accident Commission. Under the workmen's compensation laws of Oregon, Washington, and Nevada, injured workmen receive 90.8 per cent of the expenditures, while in States where insurance is carried by private companies the injured receive only 46.1 per cent. As a further illustration of the benefits of State insurance, the decisions of the Oregon Supreme Court show that there was a decrease of 64 per cent in the number of personal injury cases where the relation of employer and employe existed, according to the commission.

The Department of Forestry at Cornell University has continued its experiments in the preservative treatment of fence posts which were begun last year. The experiments aim to secure definite information on the actual increase in the life of fence posts due to treating them in three simple ways. The experiment is confined to posts of native timber and especially those which have not been used for fence posts in the past because of their poor lasting qualities. The following woods are used in the experiment: Hemlock, beech, red oak, white

ash, white elm, hard maple, red maple, yellow birch, basswood, ironwood, blue beech, hickory, and white pine. The posts are treated with hot creosote in three different ways: bushed, that is, the butt only painted with creosote in two coats; the entire post dipped for ten minutes, and last, the post given complete open tank treatment, that is, given a hot bath for an hour, then a cold bath for twenty-two hours, and then another hot bath for an hour. The posts are then set out in an experimental fence and their future conditions carefully noted. Untreated posts are also set out to serve as a check.

The preservative used is Barrett's Grade I Creosote Oil, which costs 30 cents a gallon. The results of the experiments for the last two years show as follows: Brush treatment, gain per post, 4/5 of a pound, average cost 1 1/3 cents. Dipped, gain per post, 3/5 of a pound, average cost 2 cents. Open tank, gain per post, 4 pounds, average cost, 14 cents. The experiments are to be continued until final conclusions can be drawn and then the result will be published by the university. So far the results indicate that dipping is most satisfactory for species which absorb creosote readily, whereas the open-tank process is necessary for those which resist the oil.

The experiments show that the species may be listed as follows in the order of their ability to absorb creosote in the open-tank process. The figures after each species indicate the average absorption per cubic foot.

Species	*Absorption Per Cubic Feet Pounds of Creosote*
1. Basswood	13.700
2. Yellow birch	12.200
3. White elm	7.999
4. Beech	7.486
5. Red maple	5.387
6. Red oak	5.068
7. Hard maple	3.738
8. Ironwood and blue beech	2.972
9. White ash	2.313
10. Hemlock	0.774

Hot water treatment of seeds of poor germinating capacity (especially leguminous) has been experimented with by the Dutch experiment station in Java, to find out the most effective treatment. The results showed that with some species (Crotalaria) no advantage came from steeping. With Albizzia the best result was obtained by using water at 60° C., dropping the seed into the water at that temperature and leaving them to cool for three hours. For Pithecolobium hotter

water proved preferable (70-75°), and for *Mimosa invisa* germination was easiest after treatment with water at 60 to 70°C.

A bulletin of Kew Gardens cites not fewer than 24 species of Juniperus as of economic importance, but on more closely examining the list, we find *J. californica* and *communis, macrocarpa, rigida,* and *sabina,* which are only shrubs and hardly to be classed of economic value.

An experiment made by the Railway Company of San Paolo in its engines, to determine the relative value as fuel of different species of Eucalyptus, brought out the fact that practically there was little difference and that ordinary mixed but well seasoned wood was as valuable as any.

A special director of timber supplies has been appointed by the British Government to regulate the wood trade. A special license for each importation is needed for handling foreign softwood (other than mine props). The merchant may buy at any price, but may not sell at a price higher than those current in the week ending January 31, 1917.

A new organization to control forest-fire protection has come into existence in British Columbia. Two boards of control of five members each have been organized, one for territory west, the other east of the Cascades. These boards consist of two lumbermen from each of the two districts, selected by the Lumber Manufacturers' Association, and three officials, the Deputy Minister of Lands, chairman, the Chief Forester, and the forester in charge of fire protection acting on both boards. Changes in personnel and in carrying on patrols have already been inaugurated. One change is the replacement of 163 temporary forest guards by 65 assistant rangers, who are not only employed for 6 months at $100, but are to be reengaged, and have prospects of advancement according to merit.

Another important association has been formed lately in Quebec, whose object is to assure the protection of the forest against the disastrous fires which ruined each year, since a period of at least fifteen years, many thousand dollars worth of timber. This association, which bears the name of The Southern St. Lawrence Forest Protective Asso-

ciation, was constituted at a recent general meeting of all the limit-holders of the district lying between Dorchester County and the Gaspe Peninsula.

Bulgaria's forests may be divided into four zones, according to altitude. The lowest and warmest extends from sea level up to an altitude of 1,300 feet, and is the home of the oak, elm and ash. Above this belt, up to a height of 2,600 feet, is the oak-beech transition zone. Between 2,600 and 4,300 feet is the typical beech zone. It contains ample supplies of timber. Finally a pine zone, equally well stocked, extends between 4,300 and 6,600 feet.

According to a note published in Commerce Reports for January 30, 1917 (pp. 396-8), Bulgaria's forest area in 1908 comprised 7,086,232 acres, of which 1,611,423 were national property. No statistics have been available since that date. The forests were then valued at $125,000,000, but entire sections were destroyed during the Balkan wars of 1912 and 1913.

The deciduous varieties of trees predominate in the forests of the Balkan Range. The Stara Planina region, with its beeches, willows, and poplars, is typical. The coniferous trees abound, particularly in the Rilo and Rhodope Mountains. Access to the forested ares in Bulgaria is generally difficult. This condition accounts for the fact that some 30 per cent of the total area of the country consists of forests.—Geographical Review, April, 1917, p. 325.

A survey of the world's supply and demand for matches by the Canadian Trade Commissioner at Leeds is interesting. Sweden and Norway are the main sources of supply and, before the war, Austria took third place. Germany could not compete with cheaper goods from Japan. France had a government monopoly in matches, but since the largest factories are in the section occupied by the Germans, must now import. The United States and Russia have large match industries, but as both countries have or had a high protective tariff, they could not compete in the international market. Under the revised tariff in the United States, however, Scandinavian matches have made their appearance increasingly. South America supplies itself with an inferior match. Since the downfall of the Austrian supply, India offers a good field. The Japanese control the far East Asiatic market, but in India and other European colonies they have lost ground, apparently on account of inferior quality of product. While during

the period 1907 to 1912 the match market was unfavorable, the stopping by the war of several sources of supply has given an impetus, especially to Swedish manufacturers, and prices have been very high, due in part to increase in value of raw products.

In an interesting article on food-producing trees, by Prof. J. Russell Smith, appearing in American Forestry, the following are enumerated as available in some parts of the States: Chestnut, oak (for pig food), hickory, persimmon, black walnut, mulberry, olive, honey locust, mesquite. In most cases it would be desirable to graft the wild trees in order to stimulate more prolific fruit production. The author suggests the possibility of combining fruit and wood production and at the same time utilization of waste acres on the farm. Some interesting statements are made regarding the use of black locust or other leguminous species to stimulate the production of fruit in neighbors.

In the discussions of efficiency it is a common experience that greater efficiency is claimed for private business as compared with government business. In this connection the following extract of a letter is significant, which comes from one of the brightest and most efficient foresters on this continent, the most successful organizer of a forest service, who changed into private employ with a large operating company.

Describing the character of the work he is doing, he continues: "The greatest surprise to me is the extraordinary difference in response one receives from an industrial organization and from a forestry organization. The latter I found immeasurably superior in initiative, interest, inventive resource, and application to their jobs. The class of tools one has to work with in industrial work is a discouragement."

North American Trees for Norway

During the past year Mr. Anton Smitt, a Norwegian forester, has been studying forest conditions in western North America as a representative of the recently established West Coast Forest Experiment Station in Norway. The greater portion of western Norway is now treeless, and plans for its forestation have been seriously considered. Norway spruce and Scotch pine have already been used quite largely for the purpose and also to a much smaller extent the North Ameri-

can white spruce (*Picea canadensis*). None of these species have proved entirely satisfactory, however, and attempts have been made to find others better suited for the purpose. A careful study of meteorological records showed that climatic conditions in western North America from approximately Seattle north to Sitka resemble quite closely conditions in western Norway, and gave rise to the belief that Douglas fir and possibly also other species in this region might prove desirable for introduction. This impression was strengthened by the fact that such small plantations of Douglas fir as have already been made showed an extraordinarily rapid growth.

Mr. Smitt was accordingly sent over to investigate conditions in British Columbia, Alaska, and the northwestern United States on the ground and to secure samples of seed whose origin was definitely known. The work has been very thoroughly conducted by Mr. Smitt, who has secured numerous samples of seed of a considerable number of species from a large variety of locations in northwestern North America. His collections have included seed from the coast to fairly well inland, and from sea level to several thousand feet elevation. Douglas fir has been the species of chief interest, but he has also collected numerous samples of seed of such other species as Sitka spruce, western hemlock, western red cedar, and western white pine, which might likewise prove of value. It is his personal opinion that Douglas fir from the coast of southern and central British Columbia will prove best adapted to the conditions on the west coast of Norway, and will in fact do so well as to bring about its extensive use. Mr. Smitt also made short stops in the Rocky Mountain region of Canada and the northern United States, with the object of securing samples of seed for testing in central and eastern Norway.

It is planned to grow the seed samples secured by Mr. Smitt at the nursery of the West Coast Experiment Station at Söftland near Bergen. The planting stock will then be distributed to various points on the west coast for trial under a wide variety of conditions. Great care has of course been taken to record accurate data for each sample, with particular reference to the exact locality and altitude at which it was collected, so that these experiments will yield definite results as to the best localities for future collection. The West Coast Forest Experiment Station is buying small tracts of land for experimental purposes, and hopes that eventually its work will lead to the reforestation of practically the entire portion of this section of the country, which is for the most part primarily suited to forest production.

The program of the Swedish Forestry Experiment Station for the three-year period 1915-17 includes the following projects: Best time for seed collecting and best methods of storing forest seeds; biology of germination of the most important forest trees, with special reference to the conditions of germination offered by the soil; study of the suitability of spruce seed from Germany for reforestation in Sweden; studies of different races of spruce and pine; applicability of Wagner's method of border cuttings to conditions in Sweden; extent of natural reproduction on clear-cut areas with reference to their location as regards the points of the compass; the effect of slash burning and complete clearing of the soil with respect to the supply of nitrogen in the soil; best season of the year for direct sowing in northern Sweden; study of root growth of planted trees with special reference to the most suitable time for planting; study of plantations of pine and spruce in varying mixtures; study of methods of regeneration in pine heaths; effect of thinning in both pure and mixed stands of hardwoods and conifers; effect of heavy thinning on ground vegetation; diseases and injuries caused by fungi and insects, with special reference to wind damage, nursery insects, and bark beetles; study of forest soils, with special reference to their origin and their value from the standpoint of forest productivity; study of heather lands, with special reference to their origin and possibilities for forest production; studies of swamp lands and of the transformation of moss land into forest land.

The board of directors of the Vladivostock Commercial School has plans under way to transform the institution into a polytechnic school, forestry being one of the subjects which it is proposed to introduce. The board is seeking information in regard to the organization of forest schools in the United States.

In the calendar year 1916, Canada exported $23,510,410 of paper and $24,210,911 of pulp and pulp wood as against $18,452,706 and $15,443,527 respectively in 1915, an increase of 40 per cent.

The Department of Forestry at Cornell University has compiled figures showing the percentage of Cornell graduates in forestry who go into work which utilizes their professional training.

1. New York State College of Forestry of Cornell University, 1900-1907.

(*a*)	Number receiving degree of F. E.	18
	Number now in forestry work	17
	Number in other work	1
	Per cent in forestry work	94
(*b*)	Number who studied as specials or who did not graduate	81
	Number now in forestry work	29
	Number in other work	52
	Per cent in forestry work	35

2. Department of Forestry, N. Y. State College of Agriculture, Cornell University, 1912-1917.

(*a*)	Number receiving degree of M. F.	20
	Number now in forestry work	17
	Number in other work	3
	Per cent in forestry work	85
(*b*)	Number who specialized in forestry as undergraduates, but who did not go beyond the B. S. degree	29
	Number now in forestry work	15
	Number in other work	14
	Per cent in forestry work	51

SOCIETY AFFAIRS

The Executive Council has decided not to submit to a vote of the Society the recommendation of the Washington Section with reference to universal military training and service.

A new Section of the Society has been formed, to be known as the "New York Section of the Society of American Foresters." We hope it will have a large membership and a useful career.

A petition has been received, signed by F. A. Gaylord, C. R. Pettis, W. G. Howard, F. F. Moon and Ralph S. Hosmer for the organization of a section of the Society by them to be known as "The New York Section of the Society of American Foresters." The petition has been referred to the members of the Executive Countil for action.

Intermountain Section

The Executive Committee of the Society of American Foresters approved the establishment of the Intermountain Section of the Society of American Foresters on January 17, 1917, in accordance with the provisions of Article 8 of the Constitution of the Society. This Section is to be governed by the following by-laws:

Section 1. This organization shall be known as the Intermountain Section of the Society of American Foresters.

Sec. 2. The active membership of the Section shall consist of members of the Society of American Foresters residing in Utah, southern Idaho, western Wyoming, eastern and central Nevada, and northwestern Arizona. The qualifications of the different grades of membership shall be those governing the Society except that Associate members of the Section may be elected by a two-thirds ballot of the Section. Associate members shall be persons engaged in forest work within the territory above described, who, while not possessing all of the qualifications requisite for membership in the parent Society, have completed at least three years' work of a creditable character in some branch of forest practice. Associate members may attend all meetings of the Section and take part in its discussions. They shall be entitled to vote upon all matters pertaining strictly to the affairs of the Section proper, but not upon matters pertaining to the affairs of the Society.

Sec. 3. The officers of the Section shall consist of a Chairman, a Vice-Chairman, and a Secretary, all of whom shall be active

members of the parent Society. They shall be elected by a plurality vote of all members voting at the annual business meeting of the Section to be held during December of each year and shall serve for a term of one year, or until their successors are elected. These three officers shall constitute the Executive Committee.

Sec. 4. The Chairman shall preside at the meetings of the Section and shall perform all of the duties incident to this office. In the absence of the Chairman the Vice-Chairman shall preside at the meetings of the Section. The Secretary shall keep the minutes of the Section, shall conduct its correspondence, shall announce its meetings, shall be custodian of its records, shall collect all moneys due the Section, shall have custody of all moneys received and shall make all disbursements under the direction of the Executive Committee. In the absence of the Chairman and Vice-Chairman the Secretary shall preside at the meetings of the Section. Annually on January 1 the Secretary shall render a report of the financial standing of the Section to the members thereof.

Sec. 5. The Executive Committee shall control the expenditure of all funds and shall select the speakers, subjects, and dates for meetings of the Section. Two members shall constitute a quorum in this Committee.

Sec. 6. The election of officers and other important business shall be undertaken only in business meetings of which all members of the Section have been notified at least one month in advance. Members may vote in person or by letter ballot. A majority of all members voting shall constitute a quorum. Nominations for the elective offices shall be made by a nominating committee to be appointed by the Chairman. This committee will submit a report of nominations to the Chairman two months in advance of the date of election.

Sec. 7. Open meetings of the Section shall be held at such times and such places as the Executive Committee shall decide. The purpose of these meetings shall be the interchange of ideas on subjects of interest to the profession of forestry and shall be open to friends and members.

Sec. 8. To meet the regular expenses of the Section, the Executive Committee is authorized to levy assessment as funds may be needed, aggregating not to exceed $1 per year for each member. Assessments in excess of this amount shall be levied only with the approval of the majority of the members. Expenses incurred incident to the holding of meetings and other special occasions shall be met by special contributions of those members present or interested.

Sec. 9. Nominations within the jurisdiction of this Section for membership in the Society of American Foresters shal be made only by Active members of the Society and shall be submitted through the Executive Committee of this Section. Nominations must be in conformity with the by-laws of the parent society.

Sec. 10. These by-laws may be amended by a two-thirds vote of all the members of the Section.

The Intermountain Section held a very interesting series of meetings during the winter of 1916-17, at which the attendance averaged between 15 and 20. The following subjects were discussed at these meetings:

December 4.—The Permanency of Aspen, J. M. Fetherolf; Aspen as a Temporary Forest Type, F. S. Baker; Effect of Grazing on Aspen Reproduction, A. W. Sampson; Brush Disposal in Aspen Stands, C. G. Smith; Climate in Relation to Plant Growth, A. W. Sampson.

December 21.—Relation of National Forests to Municipal Water Supply and Irrigation, J. W. Stokes; Ownership of Water Power in the United States, J. P. Martin.

January 2.—Nursery Protection, N. J. Fetherolf; Nursery Equipment, A. L. Brower.

January 16.—Uses of Grazing Reconnaissance Data, L. J. Palmer; Relation of Forest Officers to the Public, Ernest Winkler.

January 30.—Forestation Policies of the Forest Service as Applied to the Intermountain District, J. M. Fetherolf; Municipal Forestry, S. E. Bower.

February 15.—The Work of the Utah Experiment Station, F. S. Baker; Flumes and River Driving in Europe, N. B. Eckbo.

March 1.—Relation of Grazing Resources to Agricultural Settlement and Development, H. E. Fenn; Function of Grazing Studies, Mark Anderson.

March 10.—Forest Service Administrative Problems, H. S. Graves.

March 19.—Land Classification, C. N. Woods; Uses of Forest Land, R. E. Gery.

April 3.—A Course of Study in National Forest Administration, C. G. Smith.

April 18.—The Technical Forester in National Forest Administration, L. F. Kneipp.

The following members comprise the Executive Committee of the Intermountain Section for 1917: L. F. Kneipp, Chairman; C. G. Smith, Vice-Chairman; C. F. Korstian, Secretary.

The Vote on Membership Amendment

The result of the ballot on Amendments to the Constitution of the Society proposed by the Executive Council, April 20, 1917, and due June 15, 1917, is:

	For	*Against*	*Total*
Section 1, Article III—Membership	185	14	199
Section 2, Article III—Membership	185	14	199
Section 1, Article X—Dues	191	8	199
Votes cast			200
Votes disqualified (unsigned)			1
Votes recorded			199

By these amendments the membership of the Society will hereafter consist of Members, Senior Members, Fellows, Associate Members, and Honorary Members. All Active Members on the rolls of the Society June 1, 1917, become Senior Members.

Nominations for membership of any grade should be sent to Mr. J. H. Foster, College Station, Tex., Member of the Executive Council in Charge of Admissions.

The qualifications for Members and Fellows and the method of electing them is:

Members shall be:

(*a*) Men who have completed not less than four years of college work leading to a degree in forestry, or its equivalent in technical forestry training; or

(*b*) Men without collegiate training in forestry who have completed at least three years' work of a creditable character in some branch of forestry.

Candidates for membership must be recommended for election to the Society by at least three Senior Members or Fellows.

Members may attend all meetings of the Society and take part in its discussions, but shall not be entitled to vote.

Fellows shall be elected only from the grade of Senior Member. Fellows shall have completed at least ten years' work in some branch of forestry, including at least five years in responsible directive positions or in distinctive individual work of a fruitful character. They shall have the same rights as Senior Members.

Not more than ten Fellows shall be elected in any one calendar year. Nominations to this grade shall be made by seven affirmative votes of the Executive Council or by the written endorsement of 25 Senior Members or Fellows, and shall be submitted to all Senior Members and Fellows of the Society for letter ballot. An affirmative vote of three-fourths of the Senior Members and Fellows voting shall be necessary to election.

Should the candidates for Fellow receiving the vote required on the same ballot bring the total number chosen during a year to more than ten, elections to the grade shall be determined in the order of the number of affirmative votes cast; and those remaining shall be regarded as nominated for the ensuing year.

You will observe that nominations to the grade of Fellows require seven affirmative votes of the Executive Council or the written endorsement of 25 Senior Members. Since the election of Fellows can be most

conveniently conducted at the time the election of officers of the Society for 1918 is held, it is requested that all nominations to the grade be submitted to Mr. Foster on or before November 1. In view of the number of endorsements required for nomination, it is believed that the nominations can best be solicited and forwarded by the various Sections of the Society, although this course is not essential.

Washington, D. C.
June 19, 1917.

R. Y. STUART,
Secretary.

CONTENTS

Vol. XV OCTOBER, 1917 No. 6

JOURNAL OF FORESTRY

OFFICIAL ORGAN OF THE SOCIETY OF AMERICAN FORESTERS

COMBINING THE PROCEEDINGS OF THE SOCIETY AND THE FORESTRY QUARTERLY

SOCIETY OF AMERICAN FORESTERS 1900

PUBLISHED BY THE
SOCIETY OF AMERICAN FORESTERS
AT 930 F STREET N. W.
WASHINGTON, D. C.

Single Copies, 50 Cents Annual Subscription, $3.00

Entered as second-class matter at the postoffice at Washington, D. C., under the act of March 3, 1879

JOURNAL OF FORESTRY

A professional journal devoted to all branches of forestry

EDITED BY THE EDITORIAL BOARD OF
THE SOCIETY OF AMERICAN FORESTERS

The Journal appears eight times a year—monthly with the exception of June, July, August, and September.

The pages of the Journal are open to members and non-members of the Society.

Manuscripts intended for publication should be sent to Prof. B. E. Fernow, at the University of Toronto, Toronto, Canada, or to any member of the Editorial Board.

Missing numbers will be replaced without charge, provided claim is made within thirty days after date of the following issue.

Subscriptions and other business matters may be addressed to the Journal of Forestry, Atlantic Building, 930 F Street N. W., Washington, D. C.

JOURNAL OF FORESTRY

VOL. XV | OCTOBER, 1917 | NO. 6

THE DENSITY OF STAND AND RATE OF GROWTH OF ARIZONA YELLOW PINE AS INFLUENCED BY CLIMATIC CONDITIONS[1]

BY FORREST SHREVE

Desert Laboratory, Tucson, Arizona

The work described in this paper was carried out in the Santa Catalina Mountains, which are situated in southern Arizona, about fifteen miles northeast of Tucson, and form a portion of the Coronado National Forest. In the general features of their forest cover and other vegetation they are similar to nearly a score of other small ranges in southern Arizona and New Mexico. The writer has been working for several years on the climatic conditions and vegetation of these mountains, and has already described the salient features of their vegetation and given a digest of the climatological data which it had been possible to secure up to the end of 1914.[2] The Santa Catalinas are surrounded by desert plains, out of which they rise from a basal altitude of about 3,000 feet to the summit of Mt. Lemmon at 9,150 feet. The vegetation of the lower slopes is very similar to that of the surrounding desert, and it is only between elevations of 4,000 and 4,500 feet that the cacti and thorny bushes of the desert begin to disappear. At these elevations are seen the first individuals of juniper and the evergreen oaks which form the dominant element of the vegetation up to 6,500 feet. These middle elevations, which may be designated as woodland, or as encinal, are further characterized by Manzanita, Garrya, Dasylirion, Nolina, Yucca, and a large number of small shrubs and root perennials. While the lower portions of the encinal region are extremely open, the upper portions from 5,500 to 6,500 feet are nearly closed, and at 6,500 feet appear the first individuals of the large forest trees that form the

[1] The substance of this paper was read at the San Diego meeting of the Ecological Society of America, August 10, 1916.

[2] Shreve, Forrest: "The vegetation of a desert mountain range as determined by climatic conditions." Carnegie Inst., Wash. Publ. 217. 1915.

predominant vegetation from 7,000 feet to the summit. The commonest of the pines at the lower edge of the forest is the Chihuahua pine (*Pinus chihuahuana*), which is, however, not a common tree above 6,500 feet. The bulk of the forest is formed by the Arizona yellow pine (*Pinus arizonica*).

The gradual but striking changes of vegetation that may be seen on passing from the base to the summit of the mountains are accompanied by an equally striking change of climatic conditions. It has been possible to work out in a preliminary manner the gradients of vertical change for precipitation, soil moisture, evaporation, and certain elements of the temperature. In Table 1 are shown the values for some of these

TABLE 1.—*Important Elements of the Climatic Conditions Through the Vertical Range of Arizona Yellow Pine in the Santa Catalina Mountains*

Elevation (feet)	6,000	7,000	8,000	9,000
Summer rainfall (inches)	18	30	33	20+
Length of frostless season (weeks)	26	21	17	16
Length of arid foresummer (weeks)	11	9	7	6 ?
Lowest soil moisture of arid foresummer at 15 cm. (per cent dry weight)	2.6	4.0	9.3	18.6
Average daily evaporation in arid foresummer (cc., atmometer)	50–68	49–65	29	....
Depression of minimum temperature below that of Tucson (° F.)	9.2	13.7	20.1	25.9

climatic elements for the forested elevations of the mountain. Particular significance attaches to the sharp differences encountered in soil moisture and evaporative power of the air, by virtue of which the moisture conditions for plants at the base of the mountain are rendered thirty times more difficult than for plants growing at 9,000 feet.[3] At all elevations from the base to the summit, these mountains exhibit the pronounced differences due to slope exposure which are to be found in all mountains and hills in the western United States. These differences have been found to be accompanied by striking differences in soil moisture and evaporation conditions on north and south slopes, as will be seen from the data given in Table 2.

TABLE 2.—*Values for Evaporation and Soil Moisture on North and South Slopes in the Arid Foresummer Through the Vertical Range of Arizona Yellow Pine in the Santa Catalina Mountains*

	6,000 ft.		7,000 ft.		8,000 ft.		9,000 ft.	
	S.	N.	S.	N.	S.	N.	S.	N.
Evaporation (daily average in cubic centimeters)	53	47	55	44	29	29	...	...
Soil moisture (at 15 cm. in per cent of dry weight)	1.8	3.5	2.6	5.5	7.4	11.3	9.4	27.9

[3] *Op. cit.*, p. 92.

After securing the data regarding the climatic conditions of the Santa Catalina Mountains, and after correlating the distributional features of the vegetation with these data, it seemed desirable to make a further correlation between the climatic gradients and some physiological feature of one or more plants. Since the Arizona yellow pine is the predominant plant through 4,000 feet of elevation, and is easily counted, measured, and studied, it was chosen for an investigation of this character. The results given in this paper are designed to show the differences in population in this tree as growing at different altitudes, the differences in the character of the populations, and the differences or similarities in the rate of growth at the several elevations. The data which it is possible to present at this time are extremely meager, particularly from the standpoint of the forester, who is accustomed to working with large quantities of figures regarding the age of trees and the populations of given areas. The practical conditions under which the work was done made it impossible, however, to do more than secure the data embodied in this paper, which are presented more in the hope that they will be suggestive than with the feeling that they are either exhaustive or final.

For the purpose of the study of populations and rate of growth, six areas were selected, each one hectare in size. Two of these areas were located on north and south slopes in Bear Cañon, at an elevation of 6,000 feet. Two of them were located in Rose Creek, on north and south slopes, at an elevation of 7,000 feet. One was located on a south slope in Marshall Gulch, at 8,000 feet, and one was located at 9,000 feet on the south face of Mt. Lemmon. There are no areas of yellow pine at elevations below 6,000 feet, and this pine forms only a small part of the forest on northern slopes at 8,000 and 9,000 feet. These areas were selected as being typical of six distinct habitats in which the tree is found, in all of which instrumentation had been carried on. Considerable care was taken in the selection of the exact areas for study in an effort to secure slopes of uniform inclination, areas in which soil conditions were similar, and stands of pine that appeared to exhibit the

TABLE 3.—*General Diameter Classes of All Species of Trees on Six Areas Investigated in the Santa Catalina Mountains, of Altitude and Slope Exposure as Indicated*

Station	0–2.5 cm.	2.5–5 cm.	5–10 cm.	10 + cm.	Total
9,000 S.	2,525	519	139	352	3,183
8,000 S.	909	23	8	202	1,142
7,000 S.	5,876	19	10	131	6,036
7,000 N.	755	6	50	233	1,044
6,000 S.	138	19	62	249	468
6,000 N.	1,212	20	16	124	1,372

average conditions of reproduction for that region. On each of these areas the entire population was counted, including seedling trees, and the diameter of each of the trees 10 cm. and over in diameter was measured. After this enumeration a number of trees were cut in each area and their ages determined by ring count. The figures for the total populations of the six areas are given in Table 3. The individuals were grouped into four-size classes: 0–2.5 cm., 2.5–5 cm., 5–10 cm., and 10 cm. or over. The trees 10 cm. and over in size, which will be desig-

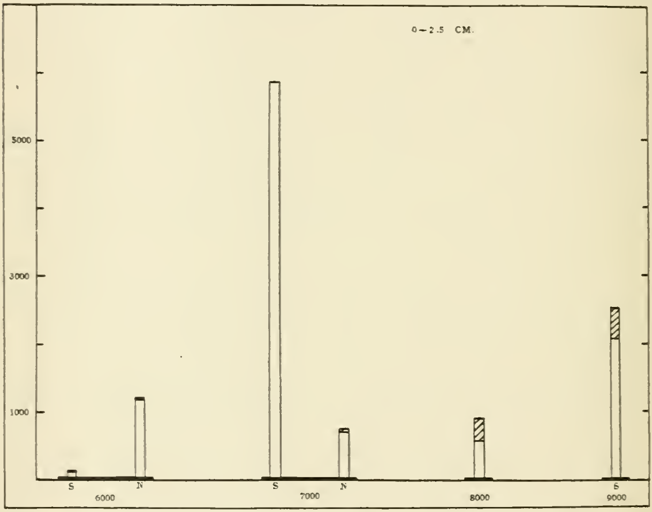


Fig. 1.—Graphs showing total number of seedling trees up to 2.5 cm. in diameter on six areas at four altitudes, the slope exposure being indicated by S. and N. Hatched portions indicate species other than Arizona yellow pine.

nated as the adults, were measured breasthigh, the juvenile classes being measured 5 cm. from the ground. The total number of adults at 9,000 feet includes 36 trees of Mexican white pine (*Pinus strobiformis*) and one of Douglas fir (*Pseudotsuga mucronata*). At 8,000 feet there were 20 adult Mexican white pines. On the south-facing area at 7,000 feet all the adults were yellow pine, while on the north-facing area at that elevation there were 23 Douglas firs and 16 white pines. On the north-facing area at 6,000 feet there were two adult junipers (*Juniperus pachyphlœa*), with one Douglas fir, while on the south-facing area

at 6,000 feet there were 53 trees of Chihuahua pine, 23 junipers, and 3 piñons (*Pinus cembroides*), as well as a number of oaks, which were not enumerated.

The trees which are associated with the yellow pine are represented in all of the areas by seedlings and juveniles in proportions approximately like those given for the adults. Figures 1, 2, and 3 give a picture of the comparative representation of the age classes at the different altitudes, the 2.5–5 cm. class having been combined with the

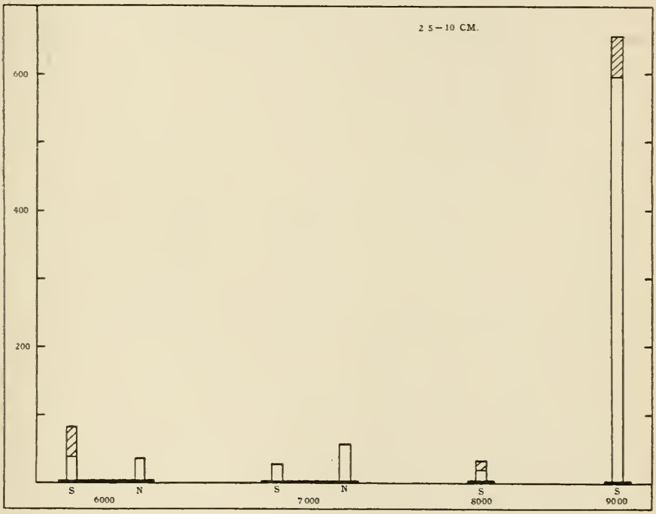


FIG. 2.—Graphs showing total number of young trees from 2.5 to 10 cm. in diameter on six areas at four altitudes. Hatched portions indicate species other than Arizona yellow pine.

5–10 cm. class. In all of these figures the shaded portions of the graphs indicate the associated species and the white portions refer to yellow pine. The enormous number of juveniles on the south-facing area at 7,000 feet (fig. 1) was due to very young seedlings of yellow pine that had not yet passed the age at which mortality ceases to be very high. The condition on this area at the time of enumeration is one that frequently occurs at all elevations resulting from a good seed crop and good conditions for germination. The decimation of such an abundant stand of seedlings is due chiefly to the low soil moisture of

May and June, which has an average value of 2.6 per cent at a depth of 15 cm. on south-facing slopes at 7,000 feet. The writer has frequently seen large numbers of dead seedling pines at about this elevation during the latter part of June, when the culminating effects of the arid fore-summer were being exerted. There is much observational evidence to support the indication of these figures that the conditions for seeding and germination of yellow pine are better at about 7,000 feet than they are at higher or lower elevations. The relatively large number (2,525)

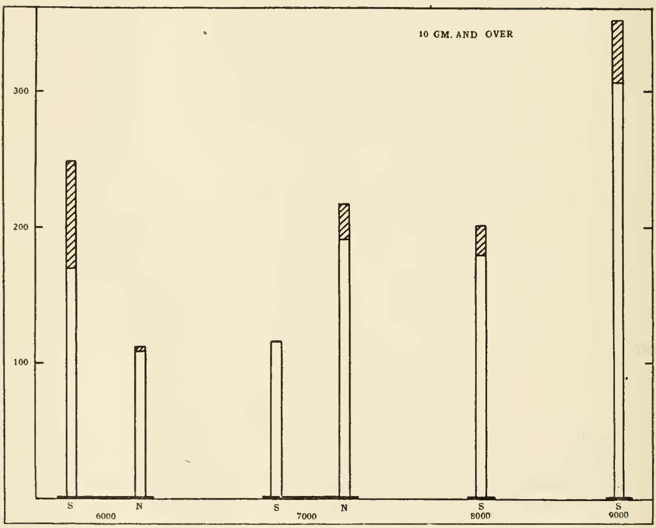


FIG. 3.—Graphs showing the total number of adult trees on six areas of the slope exposure and altitude indicated. Hatched portions indicate species other than Arizona yellow pine.

of seedlings at 9,000 feet comprised 2,079 yellow pines, but a large proportion of them had reached their second and third year of growth.

The data exhibited in figure 2 show that the number of trees which are well established, but still small, is about the same at all the lower elevations, but is pronouncedly greater at 9,000 feet. Observation throughout the forested portion of the mountain confirms these figures in their indication that the number of small and well-established pines is greater on the highest slopes of Mt. Lemmon than it is in the relatively open and park-like bodies of timber at lower elevations.

An inspection of figure 3 will show the relation existing between the adult stands of all trees and of yellow pine on the six areas investigated. A comparison of the populations of the four south-facing slopes shows the largest number of trees (352) at 9,000 feet, a smaller number (202) at 8,000 feet, and a still smaller number (131) at 7,000 feet, with an unexpected rise in the number (to 249) at 6,000 feet. The population at 7,000 feet is about one-third that at 9,000 feet, and the curve of decrease would lead us to expect about 90 to 100 adult trees per hectare at 6,000 feet, instead of the 249 trees that were found. This stand contained more associated species than any of the others, the number of yellow pines being only 171. It is possible that the density of the population of this area is influenced by the location of the hectare that was enumerated, which is on the low slopes of the north wall of Bear Canyon, near the lower end of an alluvial flat which has formed as a result of the narrowing of the canyon by a dike of particularly resistant gneiss. The hectare is entirely above the influence of the favorable soil moisture conditions of the lower end of the alluvial flat, but is partly within the influence of the cold-air drainage, which gives this locality lower minimum temperatures than those recorded at 7,000 feet. Adjacent localities of the same slope exposure are either extremely precipitate and rocky or have been burned over within the last twenty-five years. Although there is some possibility that the south-facing area at 6,000 feet bears an abnormally heavy population, the writer is not willing to regard this as a wholly typical phenomenon.

The populations of the north slopes at 7,000 and 6,000 feet show about the same reduction with altitude that is shown between the south slopes at 8,000 and 7,000 feet. One of the most interesting features displayed by a comparison of the populations on the north and south slopes is the close similarity between the total number of trees on the south slope at 8,000 feet and on the north slope at 7,000 feet, and the corresponding similarity between the figures for the south slope at 7,000 feet and the north slope at 6,000 feet. In the previous publication which has been cited, the author has shown that the vertical limits of the types of vegetation and of very many species are about 1,000 feet lower on north slopes than they are on south slopes. In other words, two slopes facing north and south at the same elevation exhibit the same differences of vegetation that will be found on two north slopes or two south slopes which are 1,000 vertical feet apart. It has also been found that the ratio between soil moisture and evaporation differs between north and south slopes at the same elevation by nearly the same amount that separates the readings on the same slope exposure

at stations 1,000 vertical feet apart. It is important to find that what we may designate as "the climatic value" of slope exposure is so nearly the same for a large number of dominant trees and shrubs, and is also the same in its influence on the size of the populations of yellow pine at

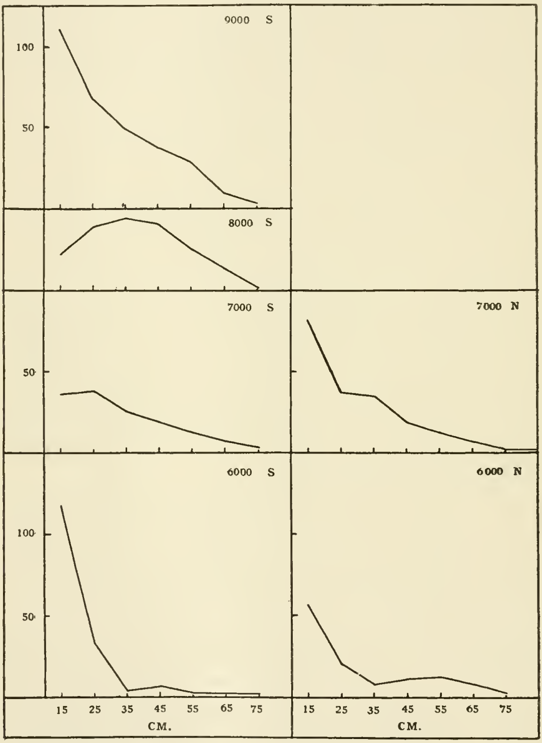


Fig. 4.—Graphs showing the composition of the adult stands of Arizona yellow pine on six areas of exposure and altitude as indicated, the diameters being grouped by 10 cm. intervals.

different altitudes. In so far as a correlation of vegetational features and climatic conditions may be taken as a proof of a causal connection between the two, it would appear that the ratio of soil moisture to evaporation is the climatic complex which controls this set of phenomena.

In order to make a more significant comparison between the popula-

tions of the six hectares the adult trees were grouped into size classes. Those between 10 and 20 cm. in diameter were grouped in the 15 cm. class, those between 21 and 30 cm. in the 25 cm. class, et cetera. The graphs in figure 4 show the make-up of the six populations with respect to the size of the component trees. The area at 9,000 feet shows the most sustained count of larger trees. The south-facing area at 6,000 feet is now seen to be made up largely (40 per cent) of trees between 10 and 20 cm. in diameter, with only a small proportion (10 per cent) of its trees exceeding 25 cm., regarding yellow pine only. If the data for the four south-facing areas were converted into the customary terms of total basal area they would show a steady decline with decrease of altitude. A few measurements of height were made in each area, which showed practical uniformity between 8,000 and 7,000 feet (50 to 70 feet), with a slightly smaller stature for 9,000 and 6,000 feet (40 to 60 feet).

On again comparing the south slope at 8,000 feet with the north slope at 7,000 feet, and the south slope at 7,000 feet with the north slope at 6,000 feet, a general similarity is discovered, but not so close a correspondence as exists between the populations alone.

Through the kindness of the officers of District 3 of the Forest Service and of the Coronado Forest, permission was secured to cut some trees in each of these areas for determination of the relation of age to diameter. From 11 to 17 trees were cut on each hectare, the selections being made with a view to securing various sizes, and giving equal representation to excurrent rapidly growing trees and more mature individuals with flat-topped crowns.

The results of the determinations of age in relation to size are shown in graphic form in figure 5. The diameters used in placing the dots are those secured by calipering the tree without removal of bark, and the age used is that found by ring count on stumps about 2 cm. high or by use of a Swedish increment borer at about 1 m. in height. Owing to the variable nature of the results, the paths of variation are indicated as well as the mean line representing increase of diameter with increase of age.

TABLE 4.—*Average Diameters (in cm.) of Arizona Yellow Pine to be Expected at Three Ages in Six Habitats of the Santa Catalina Mountains*

	50 years	100 years	150 years
9,000 S.	19	56	..
8,000 S.	8 (?)	25	56
7,000 S.	15	26	36
7,000 N.	14	28	36
6,000 S.	12	32	37
6,000 N.	16	30	40

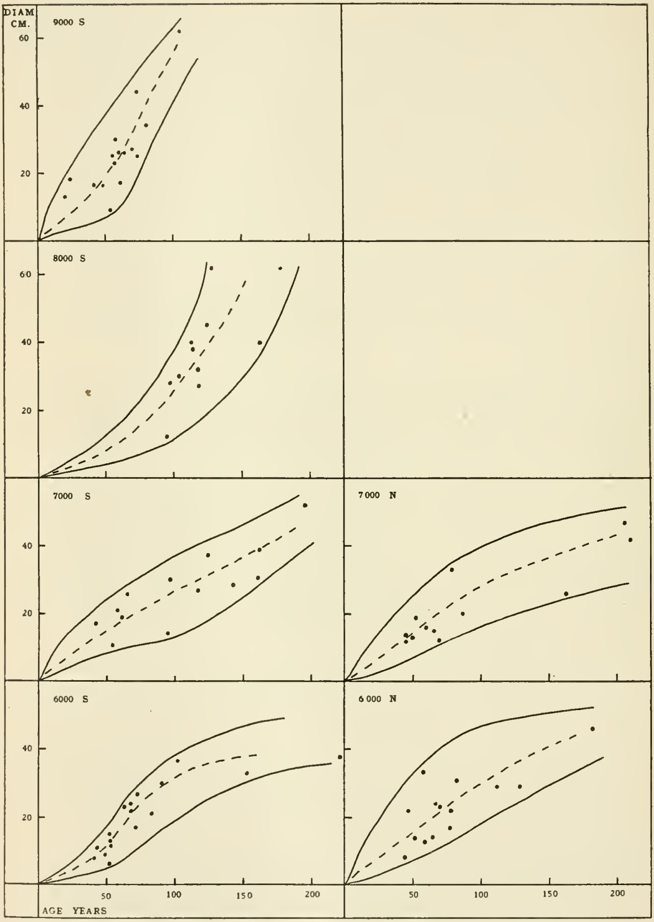


Fig. 5.—Graphs showing the average rate of growth and the paths of growth variation of Arizona yellow pine in relation to altitude and slope exposure. The broken lines show the average rate.

An examination of the paths in figure 5 shows that the 9,000-foot area stands rather sharply apart from the other areas in the growth rate of its trees. The rates at the lower elevations are so similar that their differences might well fall within the bounds of the errors of the method and the limitations of the amount of material. In order to compare the rates on the different hectares more exactly the readings have been made which are given in Table 4. These readings are based on the median lines of average growth rate, and show the mean expectancy of size for trees 50, 100, and 150 years old. The rapid growth at 9,000 feet is again emphasized in these figures. The average size at

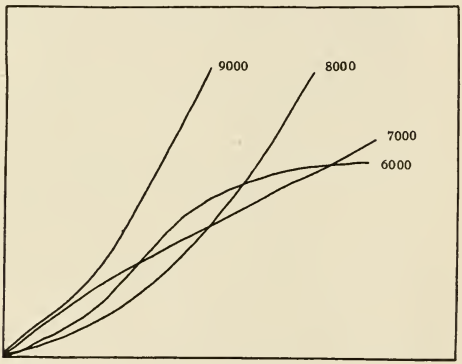


FIG. 6.—Superposed graphs of growth rate for the Arizona yellow pine on south slopes at four altitudes

50 years at 8,000 feet is obviously much too low, owing to the absence of any data for trees of about that age in the composition of the growth path. The expectancy of size at 150 years at 8,000 feet is the same as that at 100 years at 9,000 feet, and is well above the expectancy for 150 years at 7,000 and 6,000 feet. The expectancy of size at 50 years at 9,000 feet is not greatly in excess of that at 7,000 and 6,000 feet, and a true value for 8,000 feet would doubtless be of about the same amount. The expectancies for all three of the sizes at the 7,000-foot and 6,000-foot areas are very similar. Not only does the altitude fail to exert an influence, but the effects of slope exposure are completely absent. A still closer comparison of the growth rates on the south slopes at the four elevations is made by superposing the four curves of average rate (fig. 6). The curve for 9,000 feet is then seen to stand well apart from the other three, which follow nearly the same path.

The fact that the Arizona yellow pine grows at four elevations in the Santa Catalinas at which the climatic conditions are very dissimilar, and at which the associated trees, shrubs, and other plants are very different, and at the same time fails to show a marked difference of growth rate at three of these elevations, is doubtless due to the opposing action of two sets of factors. Although there is a progressive increase of rainfall from 6,000 to 9,000 feet,[4] there is a shortening of the growing season with this ascent, and it may well be that the opportunity for increased growth which is afforded by a moister soil is offset by the shorter season of favorable temperatures for growth. Nearly all of the sections of trunks from 6,000 feet show a frequent recurrence of broad rings alternating with narrow ones, the two being separated by very light and thin bands of "autumnal wood," whereas the pairs are separated by broad bands of dark autumnal wood. This points to the existence of two periods of growth at 6,000 feet, and this interpretation was used in making the ring counts. The first and greater period doubtless comes at the commencement of the growing season, when the soil is still moist from the rains of late winter and early spring. The mid-year check in growth is occasioned by the arid foresummer, which has an average length of eleven weeks at this altitude. The later and minor period of growth is probably inaugurated by the increase of soil moisture due to the rains of July and August. At higher elevations the arid foresummer is shorter and the minimum soil moisture of that season is higher (see Table 1), resulting in a later commencement of growth and an uninterrupted continuance of it. The occurrence of a double season of growth is, therefore, apparently responsible for a portion of the effect of nearly identical growth rates at 6,000, 7,000, and 8,000 feet.

The Arizona yellow pine is so closely related to the western yellow pine (*Pinus ponderosa*) that the relations of the two to environmental conditions may be taken as nearly identical. The geographical distribution of the two species—extending from British Columbia to Durango—is so wide as to indicate an ability on the part of these trees to adjust their physiological processes to very dissimilar environmental complexes. At the southern edge of the range of these trees their lower limit is undoubtedly determined by a definite value for the ratio

[4] The figure given in Table 1 for the average summer rainfall at 9,000 ft. is based on a shorter series of records than the other rainfall data. There have been some summers in which the rain was slightly less at 9,000 ft. than at 8,000 ft., but it is doubtful if this is the average condition. It is at least certain that the soil moisture is much higher in the early part of the growing season at 9,000 ft. than it is at 8,000 ft.

of soil moisture to the evaporative power of the air, as appears to be true of all trees in the desert mountain ranges. In critical years this climatic feature becomes important to the trees which are in critical stages of their establishment or are occupying unfavorable spots. The upper limit of the western yellow pine appears to be reached at about 10,000 feet on the San Francisco peaks in northern Arizona and on Mt. Graham, in the Pinaleno Mountains of southeastern Arizona.

The environmental conditions change so greatly on ascending from the lower to the upper limit of the yellow pine that a much greater difference might be expected in the growth rate, which may be regarded as a measure of the collective physiological processes of the tree. Even the small number of age determinations and the small size of the areas used in this work should have been sufficient to discover the differences of growth rate if they were as great as the differences in climatic conditions would lead us to expect. The possibility of the action of compensating factors in equalizing the growth rate, at least at the three lowest elevations, opens up a field for further investigation of this problem which seems to the writer to be an important one in the management of our southwestern forests.

FOREST SERVICE STUMPAGE APPRAISALS

By James W. Girard

Logging Engineer, Forest Service

This article deals only with the appraisal of sawlog material and the logging methods employed in Montana, Idaho, and northern Washington. The special features connected with the appraisal of chances containing such products as ties, stulls, cedar poles, mining timbers, pulpwood, and cordwood have not been considered. Practically all large sales of Government timber in this region consist largely of sawlog material.

DEVELOPMENT OF LOGGING ENGINEERING

The development of logging engineering during the last four or five years throughout the Forest Service and throughout the entire country has been remarkable. A brief history of appraisals in this region will show the progress made, methods developed, and comparative reliability of results. Up to about 1911 or 1912 the stumpage value of Government timber was either arbitrarily fixed or roughly and often inaccurately determined from a superficial examination of the area. Several large sales were made, involving many thousands of dollars, on no more reliable information concerning the cost of logging than that which could be obtained by a rough examination of only a small portion of the area. A large portion of the sales made on that basis proved unsatisfactory to the Service and unprofitable to the purchaser. Experience has proved that logging costs cannot be accurately determined unless a detailed examination is made.

The old method, which was used until a few years ago, of walking up a main drainage or across a section probably once and guessing the logging costs as a lump sum, $6 or $7 per thousand, for example, and from this guess fixing the stumpage value is a thing of the past. No timber dealer in this region now would entertain for a minute the idea of investing from $30,000 to $40,000 for a section of white-pine timber without first making a careful and detailed estimate. The estimate can be determined as closely by walking across a section once or twice as the logging costs can by a similar method. A careful examination is just as essential in the one case as in the other.

It was about 1912 when the Forest Service recognized the necessity of working out a fair, equitable, and systematic method of determining the stumpage values of various species upon various logging chances, involving different methods of operation, wide differences in operating costs, and logging investments and different degrees of risk. It was generally realized throughout the Service that the fixing of an arbitrary minimum for any logging chance or for any species as the basis for sale was neither economically sound nor practically reasonable. Each chance must be appraised absolutely on its own merits to obtain the most satisfactory results.

A number of broad-minded, experienced, and very capable men, both in and out of the Service—men who have been intensely interested—have given the subject of equitable stumpage appraisals careful consideration. General investigations and detailed studies have been made both in logging and manufacturing. These studies and investigations have resulted in a large amount of valuable information which has led to certain definite conclusions. As a result an outline has been developed for stumpage appraisals, which clearly sets forth the procedure to be followed, the factors to be considered, and the information required.[1] It is uniformly adhered to in all appraisals.

When detailed, analytical stumpage appraisals were first attempted by the Forest Service, loggers and manufacturers in general were very skeptical of the practicability of such a scheme and largely discredited the results of the examinations. It was generally believed by operators that reliable estimates of logging and manufacturing costs could not be made except by men who had had several years' experience in all of the different branches of logging and manufacturing. This line of reasoning would seem at first sight to be logical, but it will not hold true in all cases.

A LOGGING ENGINEER IS NOT A LUMBER JACK

Actual experience is undoubtedly very helpful, but not indispensable. The author believes that any intelligent man who has keen powers of observation, sound judgment, and a natural aptitude for stumpage appraisal work can develop into a capable and highly efficient logging engineer without ever using an axe, saw, canthook, or constructing chutes, sleigh roads, railroads, flumes and camps, or driving teams or operating donkeys, locomotives, and sawmills. To acquire this knowl-

[1] "Instructions for the Appraisal of Stumpage on the National Forests," issued by the Forest Service.

edge without actual experience would require several years' time, careful examination of many areas before and after logging, detailed studies and analyses of different branches of logging operations, and access to accurate records of costs. Some of the greatest engineers this country has ever known—men who have contributed the most valuable and detailed information on the cost of construction and operation of railways—are men who never used a pick and shovel, never drove a team to a scraper, or operated a steam shovel or locomotive.

If any railway company in this country decided to extend their lines in a certain locality they would not go to the foreman of a grading crew or some one who had worked many years on actual grade construction to get a reliable estimate on the cost of construction, but they would employ a capable engineer who had specialized in that line of work.

The same thing is true in appraisal work. Men learn from experience how to do work, but unless they are interested in it they may never know much about the costs. The most conspicuous progress that has been made in the efficient utilization of labor did not result from actual experience, but from careful detailed studies and a complete analysis of all the factors which lead to an intelligent application of effort.

The average lumber jack knows very little about what different parts of a logging operation actually cost, though he may be thoroughly familiar by experience with every phase of the work. The sawyer in a mill is of course best qualified to do that particular kind of work, but the bookkeeper knows more about the costs of production per thousand feet board measure, though he may not know anything about sawing.

This same line of reasoning could be extended through the operation. The difference between the experienced and inexperienced man is that the experienced man knows how to do the work, but may not know what it costs; the inexperienced man does not know how to do the work, but may be thoroughly familiar with the costs. Experience gives a man the advantage of knowing when work is efficiently done. Numerous checks during the past few years, comparing the estimated costs of logging and manufacturing operations, as reported by the Service lumbermen and logging engineers, with the final results, have convinced practically all of the skeptics that the methods employed by the Forest Service and the results obtained in the way of logging costs and stumpage values are as nearly accurate and equitable as it is possible to secure with a small expenditure.

ACCURATE LOGGING COSTS

It has been demonstrated that logging costs can be determined more accurately than a cruiser can estimate the amount of timber. In other words, the percentage of variation between actual and estimated results has been less in logging than in cruising.

If a logging chance is carefully examined by an experienced, capable, and thoroughly qualified logging engineer, the actual costs of operation should not vary from the estimate more than 4 per cent to 10 per cent, with an average of not more than 7 per cent, assuming that the operation is directed by a logger of average efficiency, and that no unusual weather or labor conditions are encountered which were not considered by the appraiser. Actual costs from a number of jobs in this region are within 4 per cent of the estimates.

There are certain fundamental principles which determine stumpage values. There are five primary factors which are fully considered in the determination of stumpage values for all large Forest Service sales. These factors are quality and quantity of timber, logging cost, manufacturing cost, and the market value of the finished product. The appraisal work is done by experienced, capable lumbermen and logging engineers. The appraisals are made upon the basis that the operators are entitled to a margin to cover the risks involved and a reasonable profit on the estimated costs of operation or on the estimated average annual profit-bearing investment.

TWO METHODS

There are two methods employed in arriving at stumpage values. These are known as the "overturn" and the "investment" methods. The overturn method is generally used in small sales where the operating costs can be easily estimated and where the investment is very small in comparison with current operating costs. This method consists of reckoning profit as a certain percentage of the total operating cost and depreciation which combined represent the "overturn."

The application of the investment method is as follows: The average annual amount of money employed in the operation, including operating capital and fixed investments, is determined. A specified percentage of the average annual profit-bearing investment gives an annual sum which must be set aside as the profit margin. This sum divided by the yearly cut gives the profit per thousand feet.

From 15 per cent to 25 per cent on the logging investment and 10

per cent to 20 per cent on the manufacturing investment is a reasonable margin when the investment method is used.

In the overturn method from 15 per cent to 30 per cent on the logging costs and from 20 per cent to 25 per cent on the manufacturing costs is considered equitable. The risk involved is the most important factor in determining the profit margin.

The cost of logging and manufacturing, plus a reasonable margin for profit and risk, subtracted from the mill-run value of the finished product, averaged for all sizes, grades, and species over a period of time (two years or more in large sales), indicates the stumpage value of the timber.

A thorough and comprehensive analysis of the factors affecting the costs of operation from the stump to the cars and a full consideration of the value of the finished product is the only proper basis from which to determine a just and equitable stumpage value for any given logging chance. The author does not believe that any practical logger or manufacturer would question the soundness and logic of this method.

RELATION TO OTHER ACTIVITIES

In connection with the Forest Service stumpage appraisals, the relation between the Office of Silviculture and its divisional parts—Timber Surveys, Logging Engineering, and Products—should be explained.

Wherever possible, a special man is detailed by the Office of Silviculture to determine the silvicultural treatment of the area, including the marking rules, marking plan, the percentage of each species to be reserved from cutting for reforestation purposes, or to form the basis for a second cut and the brush disposal. This man works with the appraisers, as a rule, but when it is not possible to have him in the party the same data which he collects are obtained by the appraisers.

Logging Engineering furnishes all data concerning the most feasible method of operation, quality of timber, logging investments and costs, manufacturing investments and costs.

The Office of Products compiles all data regarding lumber values by grades and species, average mill-run values f. o. b. cars, and conducts mill scale and lumber depreciation studies. The average mill-run value f. o. b. cars for the Inland Empire region for all species is compiled from data furnished by the Lumbermen's Information Bureau of the Western Pine Manufacturers' Association, Spokane, Washington. Practically all of the large mills in Montana, northern Idaho, and eastern Washington report sale prices to this bureau, and the average mill-

run values thus secured are more reliable and more accurate for use in appraisals than would be any estimates based on available data. The Office of Products conducted a mill-scale study during 1913 at 10 different hand mills scattered throughout the Inland Empire region. More than 12,000 logs of various species were recorded. Accurate data were secured on the percentage of grades which timber cut in different parts of the region would produce and on the percentage of overrun lumber tally over log scale, as determined by the Scribner Decimal C Scale Rule' for different species.

The mill-scale study data are sometimes used as a basis from which to figure the percentage of grades. This is done in cases where a check on the lumber values as reported by the Lumbermen's Information Bureau is desired or the timber is of unusually good or poor quality. The data secured by the mill-scale study on overrun are used in all appraisals. The overrun is based on No. 5 common and better. The table showing weighted overrun and one giving the average mill-run value of timber f. o. b. the cars from 1913 to 1916 indicates the form in which these important factors are made available.

The Timber Survey organization does the estimating and mapping on all large projects. Intensive timber surveys are made, after areas have been covered by an extensive examination to collect data concerning the stand of timber in general, the feasibility of logging, and the desirability of making a sale. The most logical logging units in localities where there is a demand and real need for the timber are covered first.

The appraisal work begins where the timber-survey work ends. The standard for timber surveys requires that 10 per cent of the area of merchantable timber shall be covered, all cruise lines chained, elevations carried with an abney level, and topographic maps made, using a contour interval of 25 feet to 50 feet or 100 feet, as the topography may require. This method of cruising, and of mapping especially, has proved to be of great value to the appraisers. The maps are accurate, and it is often possible to determine from the detailed topographic data which are furnished the most feasible method of operation before going in the field.

FIELD METHODS

Appraisals are made after there has been a definite application for the timber.[2] In large drainages or chances covering several sections

[2] On the Cœur d'Alene Forest appraisals are made of the bodies of timber which the Forest Service wishes to sell without awaiting specific application, since practically every chance is salable.

from two to three men are generally used on the appraisal work, accompanied by a specialist from the Office of Silviculture or from the Forest, to draw up the marking plan. Small areas are often worked by one man. From one-quarter to one section per day per man is about all that can be properly examined. This amount varies largely with topography, weather conditions, underbrush, and other factors.

DETAILED EXAMINATION OF AREA

The first step taken in large drainages is to make a sufficient examination of the area to determine the main transportation possibilities and to decide upon the most feasible method of operation. When this has been determined, the intensive examination follows. The creeks and ridges of the area to be worked are copied from the timber-survey map into a field-map book (on the scale of 4 inches to the mile), and when there are two or three men making the examination the work is planned from one to three days ahead.

The timber-survey estimates by 40s are also transferred to this book. Practically all logging chances containing more than one section are subdivided into smaller units. Any small creek or sidedraw which from a topographic point of view forms a natural logging unit is considered separately.

Logging costs vary widely between these smaller units in many cases, and for that reason it is necessary to keep a separate record of the costs for each subunit.

All areas which must be hand-logged are also kept separately. If a section, quarter section, or 40 is divided into several units, a copy of the creeks, draws, and ridges, showing the acreage of each unit, and the estimate showing the amount of timber on each 40 allow the determination approximately how much timber will be removed from each unit. Each creek and sidedraw is carefully examined in the field and numbered consecutively in the order of examination. The date of the examination, the number of each creek and draw, section, township, and range is recorded in a notebook.

The appraiser paces up all the draws to the limits of merchantability and plainly blazes points on the proposed sale-area boundary. He also paces up the hillsides on either side of the draw to determine the logging conditions and the limits of merchantability. The boundary is blazed at all these points, provided that merchantable timber does not extend across the ridge into the next draw. The appraiser should see every 40 in the drainage.

A brief description is written of each unit, giving logging conditions,

size, quality, and condition of the timber, its location, logs per tree, logs per thousand, necessary improvements, estimated costs of sawing, swamping, skidding and landing, brush disposal, and slashing or girdling defective trees. Such factors as per cent of slope, condition of surface, underbrush, reproduction, windfall, and average skidding distance are recorded.

The average skidding distance is a very important factor, but is often different from that shown by the map, because the heaviest stand of timber is generally near the bottom of the creeks or sidedraws. The appraiser should pace out distances for all improvements. He decides while on the ground the type of improvement most feasible for each unit and keeps a record of the estimated cost of construction. The location of railroads, flumes, sleigh roads, dray roads, scoot roads, trail chutes, gravity chutes, dams, and all other improvements is shown on the map, together with the estimated cost of construction.

The cost of construction is usually estimated in terms of rods. This is done because of the wide difference in conditions which is often found within short distances. The cost of chute construction for the first 20 rods in a certain draw might be $8 per rod and only $3 per rod for the rest of the way. The same thing is true, but generally not to such a marked degree, between different draws or small units.

There is sometimes a wide variation between all of the operating costs on different units. This is the main reason why it is so important to keep the costs of each unit separate.

It is not considered necessary to give a complete discussion of all the factors considered by the appraiser while on the ground and how the costs are determined. Mention has been made of the most important features in order to illustrate what is meant by analytical, scientific appraisals.

This method of collecting logging cost data has proven very satisfactory, and a number of checks with actual costs have unquestionably shown that the reliability of the data secured justifies the cost of the detailed examinations. As a proof of the reliability of the data, there are several operators in this region who are willing to depend absolutely on the logging costs as determined by the Forest Service appraisers.

When the field examination is completed, practically all the logging cost data are compiled and the office work is thus reduced to a minimum.

The average logging cost for the entire chance is determined by multiplying the cost for each unit by the percentage of the whole chance

represented by the timber in that unit and adding these together for the total.

Logging investments, location of camps, administration and depreciation charges are determined after the completion of the examination of the entire chance.

For convenience in the field-work, and in order that swamping, skidding, and landing costs may be determined quickly, cost tables for these items have been compiled, a sample of which accompanies this article. The one selected is for the Cœur d'Alene region, where, owing to the comparative inaccessibility of the timber, freighting costs are high. During the last 18 months labor costs have increased about 20 per cent, and the costs of certain supplies have increased even more than that. Therefore the swamping and skidding table would not be applicable now for a small job that could be completed in a short time. The table was compiled from representative figures, which covered a period of three years.

CONSTRUCTION OF TABLE

As an illustration, the following explanation is given showing how the table was constructed. During the last few years hay has averaged $16 to $24 per ton and oats from about $25 to $30 per ton in the Cœur d'Alene region. It will require from 90 pounds to 120 pounds of oats and hay per team per day, depending on the size of the team. Most operators in this locality feed about 50 to 60 pounds of hay and 40 pounds of oats per team per day.

The cost of freighting ranges from about three-fourths of a cent to one and one-half cents per pound. On this basis the cost per effective day for a team and teamster is made up as follows:

Teamster	$2.75	to	$3.00
Feeding team (including freight)	2.00	to	2.50
Shoes and nails	.10	to	.15
Barn care, medicine, etc	.15	to	.25
Feeding team during shut-downs	.45	to	.60
Totals	$5.45		$6.50

The average is about $6 per day. The above figures are based on the best available information for this particular locality. The capacities in these tables are based on actual figures from a large number of operations in different parts of the region, where practically every logging condition was encountered.

The organization, or range in the cost per crew per day, is sufficiently wide to adequately meet the varying conditions from the most favorable to the most difficult chances. The amounts handled per day, vary-

ing from 6 to 14 thousand per crew, cover from the minimum to the maximum averages. It will be noted that a skidway or landing man has been provided for each crew. This will not apply in all cases, but it is the general practice where the skidding distance is an average of not more than 250 to 300 feet. When the logs are decked, rolled into a chute or flume, or loaded on cars, the skidway man usually does a portion of this work also. When conditions are such that the landing man can take care of two skidding teams, the costs as given in the table should be reduced from 6 to 10 per cent. The need for tables of this character has been realized for some time.

USE OF TABLES

The primary requisite necessary for the application of a table of this kind is a sufficient knowledge of logging conditions to be able to determine (1) which crew is required for any given set of conditions, and (2) the amount each crew of average efficiency will handle per day.

To use these tables accurately a man should have an analytical turn of mind and should have had considerable experience in logging operations or opportunities to observe results obtained under varying conditions and covering long periods on different operations. Men without experience could use them with fairly satisfactory results if a clear description were given of the conditions requiring the different crews and the factors determining the daily output. While on the ground one can, without question, best determine the crew required for swamping, skidding, and landing and the output per day. After considering the factors affecting the costs and deciding upon the crew and the amount which should be handled per day, reference to the table gives the cost per thousand directly.

OFFICE WORK

After the completion of the field examination the next step is the office compilation of the final report. This generally requires from one to ten days, depending on the size of the chance and whether the overturn or investment method is used.

The investment method requires much more time, but it is probably more logical in large sales where the initial investment is heavy and a large amount of operating capital is required.

COST OF DETAILED APPRAISALS

The cost per acre for appraising timber varies greatly for different chances. The factors affecting the costs are: Size of chance, accessi-

bility, traveling expenses to and from the chance, general conditions on the area, and the weather conditions.

On large chances in the white-pine region the costs vary from 4 cents to 7 cents per acre, with an average of about 5 cents per acre. The costs are made up about as follows: Field, 50 per cent; office, 20 to 30 per cent; travel time and expenses, 20 to 30 per cent. The costs of appraisals in the yellow-pine and the larch-fir types are not as high as the costs given above. Small chances cost much more than large chances because the same amount of travel time and expense is generally required per acre. Assuming an average stand of 15 thousand feet board measure per acre, which is about representative for the entire white-pine type where appraisals have been made, the cost per thousand for making appraisals is three-tenths of a cent.

THE METHOD OF LOGGING

Probably one of the most important things which the appraiser must do on all logging chances is to determine the most feasible and most economical method of logging. The best way, in case of doubt of determining which of two methods is the most feasible, is to figure the costs in each case.

ANALYSIS OF COSTS

There is generally a large amount of detail considered in the field, but all the factors, both primary and secondary, can be based on a comparatively few simple facts in the final analysis. The natural or primary factors are those which determine for different parts of the operation the varying amounts of work which can be accomplished under the given natural conditions of timber and topography. The artificial or secondary factors are based upon the variables which deal with the costs as affected by labor efficiency, and such factors which depend upon the primary factors in each case directly. To take the operation of swamping and skidding as an example, the primary factors are as follows:

(*a*) Swamping:

Species; per cent and clear length of each which determines the amount of brush to be trimmed.
Undergrowth; kind, density, and size.
Windfall; amount and size.
Surface; rough or smooth.
Rock.

(*b*) Skidding:

Species; per cent of each.
Stand per acre.
Logs per thousand.
Per cent of cull.
Average distance.
Average slope per cent.
Surface; rough or smooth.
Rock.
Soil; firm or soft.

The secondary factors are: Organization, efficiency of labor, individuality of operator, kind and condition of equipment, cost of supplies, cost of freighting in supplies, wages and the like.

The only figure which it is necessary to determine in the field is the number of thousand feet board measure which a crew of average efficiency should handle in a day. This cost obviously depends largely upon the primary factors enumerated above and is derived by a comparison of these separate factors for the tract under consideration with other figures from jobs with which the appraiser is familiar. In other words, a comparison of the conditions and all factors on a chance where the costs are desired with the conditions and factors on a chance where the costs are known is the most logical basis from which logging costs can be determined. The more experience an appraiser has had in the different branches of operations, or the more opportunities he has had to observe actual results accomplished under different conditions and to analyze factors affecting costs, the better qualified he is to estimate operating costs accurately.

This example of swamping and skidding was given in order to show what is considered under that heading in the appraisal. The same procedure is followed for all the other factors when making the field examination.

TIME STUDIES

Time studies in logging operations are very valuable. Considerable data have already been collected from detailed time studies, but I do not believe that the collection of cost data from time studies can ever be used as a basis to determine costs to be used in making appraisals until the studies have been carried out under all conditions and extended over a period of several years, thus making it possible to definitely establish broad averages which will eliminate variations due to local conditions.

Time studies in logging operations would be most valuable to the logger in revealing to him the weak points in the organization and showing definitely whether or not certain classes of logs, such as very small and defective logs, are handled at a loss.

FINAL REPORT

The final report is compiled in about the following form, and under each main heading a complete discussion is given concerning any points or factors which would tend to explain the reasons for the results:

1. Description of the tract.
2. Estimate.
3. Private interests.
4. Agricultural lands. It is necessary to give full information concerning agricultural lands, because areas chiefly valuable for agricultural purposes are generally cut clean, no marking plan is necessary, and broadcast burning of the brush is permissible.
5. Silvical description:
    - *a*. Merchantable timber.
    - *b*. Reproduction.
    - *c*. Undergrowth.
    - *d*. Soil.
    - *e*. Miscellaneous.
6. Silvical system recommended.
    - *a*. Marking rules by types. (This is handled by a specialist in silviculture when possible.)
    - *b*. Brush disposal.
7. Accessibility.
8. Logging methods and costs.
    - *a*. Topography.
    - *b*. Methods to be employed.
    - *c*. Organization planned.
    - *d*. Costs.

From this point the outline will vary in accordance with the method of logging. Examples are given as Chances No. 1 and No. 2. In both instances the overturn method of appraisal is contemplated.

Chance No. 1

8. *d*. Costs:
    1. Improvements.
    2. Sawing.

3. Swamping, skidding, and landing.
4. Chuting.
5. Loading on cars.
6. Railway operation.
7. Unloading at pond.
8. Maintenance of track.
9. Maintenance of equipment.
10. Administration or general expense.
11. Brush disposal.
12. Depreciation.

9. Summary of logging costs.
10. Manufacturing costs.
11. Lumber values.
12. Overrun.
13. Appraisal.
14. Recommendations.

Chance No. 1 is on the main line of a railroad, and for that reason no charge for freighting in equipment was made.

Chance No. 2

8. *d.* Costs:
   1. Improvements.
   2. Freighting in equipment.
   3. Sawing.
   4. Swamping, skidding, and landing.
   5. Chuting.
   6. Loading on cars.
   7. Railway operation.
   8. Unloading.
   9. Maintenance of track.
   10. Brush disposal.
   11. Administration or general expense.
   12. Maintenance of equipment.
   13. Driving.
   14. Sorting and booming.
   15. Depreciation.

9. Summary of logging costs.
10. Manufacturing costs.
11. Overrun.
12. Lumber values.
13. Appraisal.
14. Recommendations.

When the investment method is used, the outline takes a little different form and is generally arranged about as follows under 8. *d*.

1. Logging—Stump to landing:
   a. Current improvements.

Under this heading are figured the costs of chutes, landings, skidways, temporary camps, or any other improvements which are constructed currently as the logging operation progresses.

   b. Sawing.
   c. Swamping, skidding, and landing.
   d. Loading, hauling, chuting, or other transportation.
   e. Decking or piling at landing.
2. Landing to mill:
   a. Loading, breaking landings, etc.
   b. Railroading, hauling, driving, fluming, or other transportation charges.
   c. Unloading at mill pond, sorting, booming, etc.
   e. Maintenance—Supplies and repairs.
   f. Brush disposal, treatment of defective trees, cutting dead snags, etc.
   g. Supervision or general expense.
3. Summary of operating costs per thousand feet board measure.

9. Fixed investment (logging).

Under this heading are given all fixed investments, such as permanent camps, main tote roads, railroads, flumes, dams, and all equipment or any other investment of a permanent or fixed character. A tabulation is made of these investments in which are provided headings for the item or kind of improvement or equipment, initial cost, years in use, annual depreciation, residual value, and average annual profit-bearing investments.[3] The working capital is also included in this tabulation.

When the average annual profit-bearing investment has been determined, from 15 to 25 per cent of this sum is set aside as a profit margin. This sum, divided by the annual cut, gives the profit rate per thousand feet board measure. The depreciation per thousand feet board measure is determined in the same way. These sums are added to the operating costs and become a part of the total logging costs.

10. Manufacturing investments.

Under this heading a similar tabulation is given to that discussed

---

[3] Page 53, "Instructions for Appraising Stumpage on the National Forests."

under "Fixed investments (logging)." From 10 to 20 per cent of the average annual manufacturing investment is set aside as a profit margin. This amount, divided by the annual cut, gives the profit rate per thousand feet of lumber. Depreciation per thousand feet is figured similarly.

Where it is necessary to construct a new mill and develop a new market a margin of 20 per cent is generally allowed, but in established manufacturing regions from 10 to 15 per cent is considered adequate.

Logging and manufacturing are usually figured separately and a higher rate of margin is allowed on logging than manufacturing.

In established manufacturing regions operating costs are much less variable from year to year, methods are more uniform, and there are not so many factors involved which affect costs.

Logging is subject to widely varying degrees of risk, caused by climatic conditions, many combinations of topographic features, and methods of operation.

Manufacturing costs can be standardized for different species and for different-sized mills. The standard manufacturing cost generally used in this region in appraisals is $6 per thousand feet board measure, lumber tally, for white pine, yellow pine, and other species which are manufactured into a highly finished product, and about $5 per thousand for larch and Douglas fir, which are largely manufactured into timber and dimension material.

DEPRECIATION

Depreciation is such a variable factor that it is somewhat difficult to determine. A brief discussion of this item of cost will show how it is determined. Flumes, railroad grades, camps, and other improvements which have no residual or wrecking value must be depreciated in the appraisal at a rate that will wipe them out at the completion of the operation.

Railroad steel will last from 10 to 20 years on a logging railroad, depending on the class of road, weight of steel, weight of locomotive, curvature, and number of ties used per mile.

Horses are figured to have an average life of usefulness for woods work of about five years, consisting of 200 working days each, or a total of 1,000 days. This figure is sufficiently conservative to take care of all losses caused by sickness and accidents. Depreciation on horses is figured at the rate of 20 per cent per annum. This, however, is not strictly correct for the reason that depreciation does not take place at a

uniform rate in a straight line, but it is sufficiently accurate for all practical purposes in appraisals.

Certain classes of small tools have a very short life. Axes will last from 60 to 100 days; saws will do satisfactory work for 120 to 150 days, and wedges last from 30 to 50 days. These items are given to illustrate how depreciation is reckoned in appraisals.

Actual figures on a sleigh-haul job, all horse skidding, covering a period of four years and involving more than 60 million feet board measure show a depreciation on small tools only of .03 cent per day per man, which includes breakage of axe handles, cant-hook stocks, etc. The total depreciation on all equipment amounts to 40 cents per thousand feet board measure.

The depreciation for sleigh haul, flume and chute chances varies from 30 cents to 50 cents per thousand when the overturn method is used; but when the investment method is used, such structures as permanent camps, flumes, and main roads are figured as a fixed investment and are wiped out by a depreciation charge instead of an improvement charge. This method greatly increases the depreciation per thousand feet board measure, but lowers the improvement cost.

It will be noted that no scaling charge was provided for in the outline already given. This cost was left out for the reason that practically all operators in this region accept the Government scale. Most companies have a check scaler, but this cost is taken care of under the heading, "Administration and general expense."

Sufficient data have been given concerning appraisals and the two methods which are used to make it clear how the work is done without going into full details for the entire operation. There is still much room for progress, development, and improvement in appraisal work. Probably the two most important features in connection with appraisals are the quality of the timber, which determines the value of the finished product, and the percentage of overrun.

TABLE 1.—*Mill-run Selling Prices of Lumber for 1913, 1914, 1915, and 1916*

	1913	1914	1915	1916
Idaho white pine	$18.76	$18.50	$18.69	$20.05
Western pine	17.52	14.99	13.70	16.40
Douglas fir and larch	12.72	10.43	8.83	12.27
Engelmann spruce	11.50	10.25	11.39	14.38
White fir	13.08	11.78	11.59	14.04
Cedar	12.66	11.55	10.72	12.05

TABLE 2.—*Total Swamping, Skidding, and Landing for Capacities*

No. crew.	Team and teamster.	Number of swampers at $2.75.	Landing men.	Doggers.	Total cost per crew per day.	Cost per M ranging from 6 M to 12 M per crew per day.												
						6 M.	6½ M.	7 M.	7½ M.	8 M.	8½ M.	9 M.	9½ M.	10 M.	10½ M.	11 M.	11½ M.	12 M.
1..	1	1½	1	0	$12.87	$2.15	$2.00	$1.85	$1.70	$1.60	$1.50	$1.45	$1.35	$1.30	$1.20	$1.15	$1.10	$1.05
2..	1	2	1	0	14.25	2.35	2.20	2.05	1.90	1.80	1.70	1.60	1.50	1.40	1.35	1.30	1.25	1.20
3..	1	3	1	0	17.00	2.85	2.60	2.40	2.30	2.10	2.00	1.90	1.80	1.70	1.60	1.55	1.50	1.40
4..	1	4	1	0	19.75	3.30	3.05	2.85	2.65	2.50	2.35	2.20	2 10	2.00	1.90	1.80	1.75	1.65
5..	1	1½	1	1	15.87	2.65	2.45	2.30	2.10	2.00	1.85	1.80	1.70	1.60	1.50	1.40	1.35	1.30
6..	1	2	1	1	17 25	2.85	2.65	2.45	2.30	2.15	2 05	1.95	1.80	1.70	1.65	1.55	1.50	1.45
7..	1	3	1	1	20.00	3.35	3.10	2.85	2.70	2.45	2.35	2.20	2.10	2.00	1.90	1.80	1.75	1.65
8..	1	4	1	1	22.75	3.85	3.50	3.25	3.05	2.85	2.70	2.55	2.40	2.30	2.20	2.05	2.00	1.90

The above table is based on the following wage scale: Team and teamster, $6 per day; landing man, $2.75 per day; swampers, $2.75 per day; dogger, $3 per day.

FOREST SUCCESSION AND RATE OF GROWTH IN SPHAGNUM BOGS

By George B. Rigg

Professor of Botany, University of Washington

Field observations on forest succession in some sphagnum bogs of the Puget Sound region have been made by the writer during the ten years of his residence in Seattle. During the summer of 1913, while employed as scientist in kelp investigation in the United States Bureau of Soils, he visited several bogs in the coastal region of Alaska from Cape Spencer to the Shumagin Islands. The bogs here reported do not include any at high elevations and do not include bogs occurring adjacent to salt water.

The writer has elsewhere[1] defined the term "sphagnum bog" as "that stage in the physiographic succession of an area during which its surface is entirely devoid of ordinary 'hard' soil, and is composed completely of living sphagnum under which is fibrous brown peat composed mainly or entirely of partially decayed sphagnum." He has also elsewhere[2] [3] described all of the bogs here mentioned except the Maltby bog. This is situated in Snohomish County, Washington, about 1,600 meters (1 mile) south of the town of Maltby. It has an area of about 32 hectares (80 acres).

I. PUGET SOUND BOGS

In general, the forest is advancing upon the bogs of the Puget Sound region. This is evidenced by the fact that in nearly all of them trees are found growing in the sphagnum, and also by the fact that seedlings are commonly found, both among these trees and extending farther out into the bog in cases where only a portion of the sphagnum has trees growing on it.

The forest that is advancing upon these bogs is largely coniferous. The tree that most commonly leads in the invasion is the western hem-

[1] "A summary of bog theories." Pl. World 19: 310-325, 1916.
[2] "The effect of some Puget Sound bog waters on the root hairs of Tradescantia." Bot. Gaz. 55: 314-326, 1913.
[3] "Notes on the flora of some Alaskan sphagnum bogs." Pl. World 17: 167-182, 1914.

lock (*Tsuga heterophylla* Sarg.). In one case, however (Maltby bog), there is a nearly pure stand of lodgepole pine (*Pinus contorta* Dougl.), and in some portions of the Henry bog there is a nearly pure stand of western white pine (*Pinus monticola* Dougl.). Other conifers found in sphagnum are giant cedar (*Thuja plicata* Don.), the Sitka spruce (*Picea sitchensis* Carr.), and the Douglas fir (*Pseudotsuga taxifolia* Brit.).

The advancing forest is always related to the forest of the Puget Sound region in general. The coniferous species mentioned above are all commonly found in the forests of the region, and each one may be the dominant element of the forest on certain areas. The Douglas fir is the commonest conifer of the region. In certain cases, however, the bog forest is not related to the forest found upon the bordering "hard" land. For instance, the lodgepole pine, which is so common in the Maltby bog, is certainly not at all common in the neighboring forest, and if it is there at all it has escaped the observation of the writer.

In no case has a bog been found where the forest stage has advanced far enough to drive out the characteristic bog flora, such as Labrador tea (*Ledum grœnlandicum* Oeder), swamp laurel (*Kalmia polifolia* Wang.), and cranberry (*Oxycoccus oxycoccus intermedius* Pip.). The nearest approach to such a condition is in the Green Lake bog, which surpasses all others examined in both the number of species of trees and the number of individuals. This can hardly be regarded as typical, since the present bog is only a small portion of the original one and is drained by ditches on two sides. The main part has been cleared, drained, and scalped and is now under cultivation as gardens.

It is quite possible that in many cases a bog succession has preceded the present forest in some portions of this region. This would seem especially probable in the case of cedar swamps. The writer has not investigated the substratum in any of these. However, late stages of forest succession, where any evidence of bog vegetation still remains, do not seem to be evident in the portions of the Puget Sound region visited by the writer.

The only deciduous trees that the writer has found in Puget Sound bogs are the red alder (*Alnus oregona* Nutt.), the bog willow (*Salix myrtilloides* L.), and the western dogwood (*Cornus occidentalis* Cov.). Even these are rare. On the borders of one bog (Mud Lake bog), where it is advancing on the open water of the lake, the peat-bog birch (*Betula glandulosa* Michx.) is very common, but it is evidently a pioneer along with Labrador tea and swamp laurel in the formation of the bog stage and is not to be regarded as an invader of the bog.

Border of Henry bog. White pine in sphagnum. Coniferous forest, mainly Douglas fir on hard land. Pine seedlings in foreground.

White pine and hemlock in Henry bog. Ledum in foreground

Tundra with patches of bog at Yakutat, Alaska. Dead spruce trees

The western dogwood, an aspen (*Populus tremuloides* Michx.), and a crab-apple (*Pyrus rivularis* Bong.) are found in the marginal ditch of some bogs; but the writer has not found any of these species, except the dogwood, present in the actual bog stage in any case. A few specimens of this dogwood occur in the Green Lake bog.

The advance of forests on Puget Sound bogs is very slow and the individual trees that have obtained a foothold are much stunted by the bog conditions.[4] Their growth in both height and diameter is very slow.

The writer's data on the rate of growth of trees outside of bogs were secured mainly from logged-off lands where natural reforestation is going on. The region in the vicinity of Silverdale in which many of the observations were made is hilly and the soil is stony and infertile. It is very dry in summer.

The counts and measurements in all habitats were made at a height of 10 to 15 cm. (4 to 6 inches) from the base of the tree except in the case of very small specimens. In these the measurement was at the very base. In the case of trees growing in sphagnum, it is often difficult to determine the location of the base of the tree exactly without actually pulling up the tree.

In the field-work the trees were cut close to the base and a short section of the stem was cut off and taken to the laboratory, where the end was smoothed with a knife and the annual rings counted with the aid of a hand lens. In the case of very small stems a razor section was prepared and the count of rings was made under a compound microscope. In all, data were secured from 63 trees growing in sphagnum and 61 in other habitats.

Leaving out the detail of measurement for lack of space, the average annual rate of growth in bogs and outside of them is summarized in the following table:

Average Growth of Conifers in Bogs and Outside of Them

A. Diameter

Species	In bogs		Outside		Per cent in bog
	No.	*mm.*	*No.*	*mm.*	
Western hemlock	13	1.01	7	1.56	64
Western white pine	9	.78	11	1.34	58
Giant cedar	11	.60	6	1.15	52
Lodgepole pine	9	.78	21	1.57	49
Douglas fir	21	.86	16	1.69	40

[4] For discussion of bog conditions, see Rigg, G. B.: "A summary of bog theories." Pl. World 19: 310-325, 1916, and the literature there cited.

B. Height

Species		In bogs		Outside	Per cent in bog
		cm.		*cm.*	
Western hemlock..................	..	7.37	..	17.07	43.1
Western white pine................	..	5.39	..	8.62	62.5
Giant cedar........................	..	6.45	..	18.55	34.7
Douglas fir........................	..	6.32	..	20.93	33.1

The averages in B are figured from the data for all the trees represented whose height had been noted, except in the case of lodgepole pine, which has been omitted, since the height of only one tree in a bog had been recorded. The per cent for each species in the last column is obtained by dividing the number in the first column by the corresponding number in the second column, and therefore represents, on a percentage basis, the amount of growth in the bog as compared with the growth outside.

The quotient obtained by dividing the total diameter of all individual trees reported in bogs by their total age is 0.83, while the quotient thus obtained for all trees reported outside of bogs is 1.30. It thus appears that, computing by individuals (not by species), the average rate of growth in diameter of all trees reported in bogs is 63 per cent of the average growth in diameter of all trees reported outside of bogs.

Figuring in the same way, it is found that the average annual growth in height of all individuals reported in bogs is 6.26 cm., while the average for all individuals outside of bogs is 16.47 cm. For the individuals reported the growth in height in bogs was 37 per cent of the growth outside.

This should mean that the trunks of trees in bogs should show a more decidedly conical shape than trees outside. This conclusion was checked by observing a number of individuals in both habitats and was found to be correct.

The western hemlock is the commonest tree in Puget Sound bogs. In so far as the above data can be taken as representative of the region, it grows in diameter more rapidly in bogs than any other species, and also the ratio of its rate of growth in bogs to its rate of growth outside is greater. It also excels all other species in absolute growth in height in bogs. If we consider the ratio of the rate of growth in height in bogs to the rate of growth in height outside of bogs, it is surpassed by the western white pine only. The western hemlock thus seems to be by far the most successful invader of Puget Sound bogs. It is found in every bog examined in the region that is far enough advanced to have trees in it at all, while the western white pine occurs in only one

(Henry bog). The hemlock is also the pioneer in the advance of the conifers in a large majority of cases, although not in all. The western white pine is the pioneer in a part of the Henry bog, the lodgepole pine in much of the Maltby bog, and the Douglas fir in small portions of the Fauntleroy bog. Hemlock makes up only a very small part of the forest in the neighborhood of the bogs examined, while Douglas fir makes up a very large part, probably 90 per cent in many cases.

The Douglas fir occurs in only two of the bogs examined (Fauntleroy and Green Lake). It is the lowest of the five species reported in the ratio of its growth in diameter in bogs to its growth in diameter in other habitats, although in its absolute rate of growth in bogs it is higher than the lodgepole pine and the giant cedar. It is also the lowest of the five species in the ratio of its rate of growth in height in bogs to its rate of growth in height outside of them. Its rate of growth in height in bogs is greater than that of the giant cedar and the western white pine.

Some data on the growth of Puget Sound conifers under good forest conditions have been found in literature. The data are mainly from older trees than those reported by the writer and are based on a larger number of trees. The measurements and counts were all made at a height of 4.5 feet. It will be noted that comparisons as to the relative rates of growth of the various species in bogs and outside of them, based on the work cited in the following paragraphs, would not in all cases be consistent with those mentioned above. While it thus appears that the data at hand are insufficient for exact conclusions as to relative growth rate of the different species, the general fact of very slow growth in bogs is brought out strikingly. Allen's[5] graph indicates that western hemlock in the open grows in diameter at an average annual rate of 4.7 mm. from its twentieth to its fortieth year, while in the shade its rate for the same ages is 2.5 mm.

Rockwell[6] states that the average diameter of 650 specimens of western white pine forty years of age measured was 7.5 inches. This is an average annual growth in diameter of 4.68 mm. In discussing his data he says: "Although in the early seedling stage the growth of the western white pine is comparatively slow, after the young tree becomes thoroughly established it is one of the most rapid growers of the forest. . . . These figures are for average soils." The writer's measurements of the growth of this species were all made near Silverdale, Washington, on specimens growing on hills in very dry, stony soil.

[5] Allen, E. T.: "The western hemlock." Bull. 33, U. S. Bur. For., 1902.
[6] Rockwell, F. I.: "White pine in four Northwestern States." West Coast Lumberman, Oct. 1, 1916, p. 20.

Hanzlik's[7] table for the growth of lodgepole pine indicates an average annual growth in diameter of 4.5 mm. for the years from the twentieth to the twenty-fifth and 5 mm. from the twenty-fifth to the thirty-fifth. The forest on which his investigations were made is in east central Oregon.

A table for Douglas fir given by Munger[8] shows an average annual increase in diameter of 0.43 inch from the tenth to the twentieth year and 0.38 inch for the following decade. This is an annual average of 10.12 mm. for the twenty years. His table is based on 1,807 stump analyses. His data were obtained from a number of typical localities all west of the Cascade Mountains and east of the Coast Range from the Canadian line in Washington to Cottage Grove, Oregon, on the better class of soils. He calls attention to the fact that the most rapid growth is made where the soil is deep, loamy, fresh, and well drained, where the growing season is long and the stand fully stocked but not overcrowded. He says: "It is not unusual for trees from ten to thirty years old to add 4 feet to their height and three-fourths of an inch to their diameter in one year."

The West Coast Lumberman[9] gives data on the growth of the Douglas fir which indicates an average growth of 8.75 mm. in diameter for the years from the twentieth to the thirtieth.

Many of the measurements made on Douglas fir by the writer were on the stony soils near Silverdale, Wash.

Annual Growth of Conifers in Diameter Outside of Bogs

	Writer's data	Data of other workers	Ratio
	mm.	*mm.*	
Western hemlock	1.56	3.6	2.3
Western white pine	1.34	4.68	3.5
Lodgepole pine	1.59	4.8	3.0
Douglas fir	1.69	9.43	5.5

The above table summarizes the foregoing results and compares them with those of the writer. It is seen that all of the forest workers have found these conifers growing much more rapidly than the writer has, the ratio for the different species varying from 2.3 to 5.5. The difference in the character of the soil, the amount of moisture in soil and in air, and the age of the trees are doubtless among the most important factors in these differences. The comparison merely empha-

[7] Hanzlik, E. J.: "A growth and volume study of lodgepole pine in the Ochoco Mountains." Forest Club Annual, Univ. of Wash., 4: 27-33, 1916.

[8] Munger, T. T.: "The growth and management of the Douglas fir in the Pacific Northwest." U. S. Forest Circular 175, 1911.

[9] "Douglas fir." The West Coast Lumberman, Dec. 15, 1913, p. 35.

sizes the fact that these conifers, even when growing under the most unfavorable conditions, outside of bogs grow considerably more rapidly than they do in the bogs. The ratio of the growth in diameter under the conditions observed by the forestry workers to that observed by the writer, in bogs, is as follows for the species compared:

Western hemlock	0.87
Western white pine	.166
Lodgepole pine	.163
Douglas fir	.091

Very small specimens of the conifers fruit in the bogs. In the Maltby bog the lodgepole pine is commonly found bearing apparently perfect cones when not over 1 meter (39 inches) tall. The bog trees are, however, all erect, none being prostrated by the bog conditions. They seem to have good anchorage in the substratum of the bog. Of course, the gradual addition to the surface of the bog due to the growth of the sphagnum tends to bury the base of the tree, but this accumulation of material is slow. Two specimens of lodgepole pine in the Maltby bog were dug up and the level at which the growth of the tree from the seed had begun was found to be quite evident. The evidence from the two cases seemed to be that the addition of surface material had been at the rate of less than 1 centimeter (0.4 inch) per year. The roots, however, had penetrated to a considerable depth—deeper than they do in ordinary soil in the same region. That the anchorage is secure is indicated by the fact that the writer has never found a tree blown over in a bog, although trees of the same species and of similar size are frequently found overturned when growing in the open in ordinary soil.

The most dense growth of trees seen by the writer in any undrained bog of the region is in the Maltby bog. There is scarcely any place where the distance from one specimen to another measures 5 m. (16 feet), and in many places there are as many as ten small trees growing in one square meter (11 square feet) of sphagnum. The bog is advancing upon an open lake in its center and the trees are only a few meters back from this lake. The ordinary bog flora (Labrador tea, swamp laurel, cranberry, sundew (*Drosera rotundifolia* L.), and *Sphagnum* sp.) persists, however, even where the trees are most crowded.

The dominant tree in the invasion is, as mentioned above, the lodgepole pine. In general, the trees are very small, although some specimens reach a height of 4 meters (13 feet). There are many specimens only a few centimeters high. The smallest ones found were only 7 cm.

(2¾ inches) high. In some portions of this bog the western hemlock occurs along with the pine. The individuals are mostly small, only occasional ones being as large as the largest of the pines. The bog occupies nearly the entire width of a portion of a valley extending almost due south from the town of Maltby, Wash. The marginal ditch[10], so characteristic of sphagnum bogs, is found on the west side. On the east side the marginal ditch has not developed in quite the usual way because of the presence of a stream, which flows south into Graham Lake less than 400 m. (¼ mile) from the southern border of the bog. Although this stream has a fairly good current, its rate of flow has not been sufficient to cut a deep channel. The width of the stream is about 0.5 m. (1.5 feet) and its depth is about the same. The surface of the water is usually almost even with the surface of the soil, but with slight floods it spreads a good deal, and in the swamp and along it the crab-apple and the black twin-berry (*Lonicera involucrata* Banks.) are common. There is a large swampy area immediately north of the bog and a much smaller swamp on the south separates it from Graham Lake. These swamps contain no conifers. Hard-hack (*Spiræa douglasii* Hook.) is common on the borders of this bog, as it is of many bogs of the region.

The growth of western white pine in the Henry bog is quite abundant in many places, although there are considerable areas that are entirely free from trees. In some portion of the bogs there are almost as many hemlocks as pines and in a few places small cedars are found among them. No Douglas fir has been found, although the forest bordering it is largely composed of that species. The species of pine occurring here is found among the fir in this forest, but is much less abundant than in the bog. Cedar is also found in this forest. The writer has not found Sitka spruce here, although he found one specimen of it in the marginal ditch on the west side. Crab-apple, aspen, and hard-hack are common in the broad marginal ditch on the east side of the bog.

Some of the pines in this bog reach a height of 18 m. (60 feet) and a diameter of 38 cm. (15 inches). A few of the hemlocks are 8 m. (26 feet) high. The smallest seedlings found are of pine. Many of these are only 10 to 20 cm. (4 to 8 inches) high. A good many pines are dead, while others have some dead branches. All of the trees are badly overgrown with lichens. It is evident that a heavy growth of lichens does contribute to death of branches or even of whole trees of

---

[10] Cf. Shaw, C. H.: "The development of vegetation in the vicinity of Woods Hole." Bot. Gaz. 33: 449, 1902.

some species in the Puget Sound region, but the writer cannot say what may be the relative importance of this as compared with edaphic factors in injury to trees in this and other Puget Sound bogs.

It was noted that in many cases branches were better developed on the south side of the trees than on the north side. It was found also that the annual growth of the trunk in diameter was greater on the south side than on the north.

As previously noted, the small portion of Green Lake bog that now remains is partially drained, and forest succession has progressed farther there than in the other bogs mentioned. The growth of hemlock, fir, cedar, and spruce is dense. Spruce is abundant in the marginal ditch, and hemlock, fir, and cedar are common in the neighboring forest. A few specimens of western white pine occur in the forest on the hillside bordering the bog, but none have been found in the bog. Alders 3 m. (10 feet) high are found in the sphagnum, but this tree is a very rapid grower and the specimens may not have been more than four years old. A species of willow is common in this bog and one specimen of the western dogwood was found. All of the deciduous trees found may have invaded it since it was drained.

During the autumn of 1916 Lake Washington was lowered about 2 m. (7 feet) by the opening of the Lake Washington Canal. A few weeks later a ditch was cut from Mud Lake to Lake Washington, and the former was thus lowered to the level of the latter and reduced to about one-fourth of its former size. This has greatly modified conditions in Mud Lake bog. Much of it is very young and has but few trees on it. Hemlock is fairly common on the borders, but large areas of sphagnum are entirely free from trees. The hemlocks vary in size from small seedlings up to a height of 9 m. (30 feet). There is only one tree of this extreme size. It has a diameter of 30 cm. (1 foot). It is among the largest trees found by the writer in the bogs of the region. There are two specimens of western white pine in the border of this bog. One of them is 7.5 m. (25 feet) tall. There are also a few cedars. An occasional willow has found a foothold in the margin of the sphagnum. The peat-bog birch, as previously mentioned, is common along the advancing border of the bog and is a forerunner of the bog rather than an invader of it.

Fauntleroy bog is pretty thoroughly covered with a mixed growth of western hemlock, Douglas fir, and giant cedar. Hemlock is much the most abundant, fir and cedar following in that order. The largest trees are hemlock, three individuals being especially conspicuous by reason of their size. Following are the sizes of these three trees: Thirty feet

by 10 inches; 35 feet by 1 foot; 40 feet by 1.5 feet, the diameters being measured at base.

There are a good many hemlocks 6 m. (20 feet) high, and there are numerous individuals of all sizes down to 15 cm. (6 inches) in height. They nearly all have the stunted appearance common to bog trees in this region. Many of them are dead in some portion, particularly at the top. The trunks of the larger specimens show the distinctly conical form commonly seen in bog trees—that is, they have grown in thickness near the base disproportionately to their growth in height.

Willows and alders are abundant in the marginal ditch, but they stop short at the edge of the sphagnum. Hard-hack is abundant in the marginal ditch and in the large swamp which borders the bog on the north. Douglas fir is more abundant in this bog than in any other examined. The largest specimens are 2 meters (6.5 feet) high. Seedlings are not very abundant. Seedlings of giant cedar are abundant and some trees reach a height of 5 m. (16.5 feet).

2. ALASKA BOGS

In the Alaska bogs visited, the advance of the forest is less conspicuous than in the Puget Sound bogs. In many cases the trees are prostrate in the bog, although the same species grows erect alongside it. In some cases (Three Saints Bay and Sand Point) the bogs are in treeless regions, so that the question there is really the advance of alpine shrubs rather than of trees. The presence of broadleaf species in bogs is also much more common in Alaska than in the Puget Sound region. Species of birch and of willow are common. Both are real invaders, though often much stunted and frequently prostrate.

The conifers have invaded the small patches of bog found in the tundra at Dixon Harbor (long. 136° 57′ W., lat. 58° 22′ N.). The three species of conifers found in both bog and forest are lodgepole pine, Alaska cedar (*Chamæcyparis nootkatensis* Spach.), and the Sitka spruce. The only conifer found in the forest, but not in the bogs at this point, was the Alpine hemlock (*Tsuga mertensiana* Sarg.). This species, along with the others, had found a foothold in the thin layer of living mosses and decaying organic matter overlying the rocks and constituting the substratum of the tundra, but had not yet progressed into the sphagnum.

The peat-bog birch is found in these bogs. It tends to become erect in them and sometimes reaches a height of 30 cm. (1 foot), while it is prostrate in the crevices of the near-by rocks. It was not found in the

tundra or the forest. The alder (*Alnus sinuata* Rydb.) is common in the forests and the tundra and along watercourses, but was not found in the bog.

The trees in the bogs and tundra were much distorted and were frequently sprawlingly prostrate, although they maintained an erect position and symmetrical form in the neighboring forest.

In the small areas of sphagnum that have reached the bog stage in the Yakutat tundra (long. 139° 45′ W., lat. 59° 33′ N.) the Sitka spruce is a real invader. It is erect, though much stunted. The relations of sphagnum to the growth of this species in this region are further discussed under the head of the general relation of sphagnum to forests.

The sphagnum bog examined on the border of the town of Cordova had a forest of Sitka spruce and alpine hemlock extending down the hillside to its very border. No hemlock was found in the sphagnum, but a few spruce trees were found. They were badly stunted, none of them being more than 70 cm. (2.5 feet) high. They branched so much to one side that they had an almost prostrate appearance.

The bogs at Three Saints Bay, Kodiak Island (long. 153° 28′ W., lat. 57° 8′ N.), are in the region having no forest. The alder occurs commonly up to the borders of these bogs, but not in them. A paper birch (*Betula papyrifera alaskana*) reaches a maximum height of 4.5 m. (15 feet) in the vicinity of these bogs, but where it has invaded the bog it is misshapen and almost prostrate, not attaining a height of more than 1.5 m. (5 feet). Another species of birch, possibly the peat-bog birch, is prostrate in the bog.

At Sand Point (long. 160° 10″ W., lat. 55° 20′ N.) there is a small bog in the treeless region. The willows and alders of the region are much stunted, none of them reaching a height of more than 1.6 m. (5 feet). Neither of these, however, has entered the bog. The net-veined willow (*Salix reticulata* L.), some 15 cm. (6 inches) high, is abundant in the sphagnum. A birch, probably the peat-bog birch, is also fairly common.

3. SPHAGNUM AND FORESTS

Sphagnum grows in many places in the Puget Sound region and in Alaska, both in forests and other moist habitats. It was found by Dr. T. C. Frye and the writer on logs in a ravine near South Bend, Wash., in 1908. There are patches of it among the hard-hack in the swamps bordering Henry bog, Green Lake bog, and Maltby bog. It was found very common by the writer at Yakutat, Alaska, on logs, stumps, and

soil in the forest, around the edges of ponds in the open, and on soil among other plants in the tundra. It was found by the writer growing on logs at Juneau, Alaska, and also on the sandy flat bordering the glacial stream flowing into Dixon Harbor and in the open coniferous forest at Port Chatham, Alaska.

Much of the large tundra area at Yakutat within which the patches of bog occur is characterized by dead spruce trees, some up to 12 m. (40 feet) high. It seems probable that the forest here antedated the mosses, and that when these mosses came in they killed the forest through "swamping" in somewhat the same way Nilsson[11] found that they did in certain parts of northern Sweden. The region of dead trees seemed to mark the skirmish line of the battle between the tundra and the forest—a battle which the tundra is slowly but steadily winning.

Turesson[12] found an old stump *in situ* buried under the sphagnum in the Green Lake bog. On the basis of this and other evidence, he concludes that a forest has been devastated by the advance of the sphagnum. He cites Blytt[13] on the alternation of strata of sphagnum and forest in Norway and Geike[14] on similar conditions in Scotland.

It thus appears that while the forests in both the Puget Sound region and Alaska are usually advancing upon the sphagnum and show signs of eventually becoming climax, there is some evidence of the reversal of this relation. Apparently the killing out of forests by "swamping" because of a heavy growth of sphagnum has occurred in the past, and there are some early stages that indicate a tendency in that direction at present.

The following is a list of the bogs discussed in this paper, with the trees that occur in each. The first six are in the Puget Sound region. The others are in Alaska. The trees in No. 10 are small Alpine shrubs:

1. Henry bog. *Pinus monticola, Tsuga heterophylla, Thuja plicata.*
2. Green Lake bog. *Tsuga heterophylla, Pseudotsuga taxifolia, Thuja plicata, Picea sitchensis, Alnus oregona.*
3. Mud Lake bog. *Tsuga heterophylla, Pinus monticola, Thuja plicata, Betula glandulosa, Salix myrtilloides.*

---

[11] Nilsson, A.: "Om Norrbottens myrar och forsumpade skogar." Tidskrift for skogarshushalling, 1897; also Separat Abdruck, 22 pp., Stockholm, 1897.

[12] Turesson, G.: "*Lysichiton cumtschatcense* (L.) Schott, and its behavior in sphagnum bogs." Am. Jour. Bot. 4: 189-209, 1916.

[13] Blytt, A.: Essay on the immigration of the Norwegian flora during alternating rainy and dry periods. Christiania, 1876.

[14] Geike, J.: "On the buried forests and peat mosses of Scotland and the changes of climate which they indicate." Trans. Roy. Soc. Edinburgh 24: 1867.

4. Fauntleroy bog. *Tsuga heterophylla, Pseudotsuga taxifolia, Thuja plicata.*
5. Maltby bog. *Pinus contorta, Tsuga heterophylla.*
6. Dixon Harbor bogs. *Pinus contorta, Chamæcyparis nootkatensis, Picea sitchensis, Betula glandulosa.*
7. Cordova bog. *Picea sitchensis.*
8. Three Saints Bay bog. *Betula papyrifera alaskana.*
9. Yakutat bogs. *Picea sitchensis.*
10. Sand Point bog. *Salix reticulata.*

RECENT FORESTRY PROPAGANDA IN THE PHILIPPINES

By Forsythe Sherfesee[1]

Adviser in Forestry, Chinese Government

Whatever may be the political future of the Philippines, the ultimate success or failure of forestry in the islands must depend, if not wholly, at least in a very large degree, upon the Filipinos themselves. Neither Americans nor any one else can really do much more than to point the way. It must rest with the great body of the Filipino people to decide whether the movement shall be continued and strengthened, or whether it shall be allowed to sink into more or less gradual decay. If America should at any time decide to withdraw completely from the Philippines, these statements are obvious; if the present political relationship is continued, it is reasonably sure that the autonomy of the Filipinos will be steadily increased, and already their power and influence in the legislature and in the executive branches of the government are very large. But even if, for the sake of argument, America should retract the liberal policy which has been rapidly and consistently followed since the establishment of civil government, and should institute and maintain an autocratic control, forestry in the Philippines would be no more than an artificial and comparatively ineffective institution, without the sympathetic co-operation of the inhabitants themselves. Under autocratic conditions there would be no great difficulty in planning and securing the adoption of an ideal system of forest conservation—on paper; but its practical application throughout the 60,000 square miles of forests in the archipelago would be a very different matter—forests scattered over hundreds of islands, large and small, mostly with a rugged, mountainous country, difficult of access even under the most favorable conditions, where trails are poor or lacking altogether, where means of communication and transportation are primitive and few, and which are inhabited, if inhabited at all, by people who would find it not very difficult to ignore the forest laws if they should strongly so desire.

On the other hand, the Filipino is innately a very law-abiding person. He has many admirable, and some very lovable, characteristics. He is, I think, the most honest person I have ever known. Of course there are thieves and cheats—no more than any other people have the Fili-

[1] Formerly Director of Forestry, Philippine Islands.

pinos attained moral perfection—but their percentage is lower in the Philippines than in any other country of which I have knowledge. He is accustomed to authority, and does not resent it in the same degree that holds in the case of people who have inherited a stronger sense of individual freedom, as in the Anglo-Saxon or republican countries. If he is given clearly to understand what he may do and what he may not do; if he realizes the punishment that will result from his misdeeds; if he can be made to appreciate that the laws imposed upon him are primarily for his own benefit and for that of his relatives and neighbors, and not merely for some distant and vaguely understood class or government, the chances of a fair observance on his part are very good indeed. I am convinced that a large percentage of the infractions of the forest law in the Philippines are committed not with a conscious intent to break the law or to cheat the government, but from the lack of a clear realization of just what the law permits, and what it prohibits, and why.

When a forest station is first established in a region which hitherto had been left wholly or practically alone, there is, as might be expected, more or less opposition on the part of the forest users to the restrictions to which henceforth they must submit—restrictions which, for the most part, consist in requiring the payment of small fees for the cutting of public timber for commercial (not personal or domestic) use and the observance of simple cutting rules, easily understood. They and their fathers before them had been accustomed to do pretty much as they pleased in the public forests, cutting and destroying them at will. There had been no effective agency to restrict their depredations, or even to insist upon the payment of the legal charges for the timber cut and sold. In fact, it is not stretching the truth to say that many of those who cut the timber did not realize that any charges were due. They, not unnaturally, regarded the public forests as much their own as the water which flowed by in the creeks and rivers. When they are first told by forest officers that the timber on the neighboring hills and mountains belongs not to them, but to the government (an institution vaguely known and connected in their minds more or less directly with police and fines), and that they must obtain a license and pay for all timber designed for commercial as distinguished from personal or domestic use, that caingin-making[2] is prohibited, and will be rigidly punished, they naturally at first feel that an inherent right is being taken away from them, and complaints and violations are to be expected.

[2] Caingin = a Tagalog word meaning a clearing in the forest for purposes of *temporary* cultivation.

Much the same happened in the West during the early days of National Forest administration, and is doubtless now occurring in the more isolated portions of the Appalachians; but there is this difference in the Philippines—the people are essentially easier to deal with, and the establishment of effective control and of a fair degree of acquiescence on the part of the inhabitants can be brought about more quickly and more easily in the Philippines than is generally possible in America. Friction and difficulties of various kinds occur, but with the exercise of firmness, rigid justice, and tact on the part of director, chiefs of divisions, and of the forest officers generally, and especially through patient, unending explanations, in the simplest terms and using the simplest analogies, a new and more satisfactory spirit is brought about in a time surprisingly short when the intellectual level of the people and their past history are taken into consideration.

But it is by no means only the ignorant, illiterate laboring class in the provinces who must be given a sympathetic understanding and appreciation of the ideals and objects for which the Bureau of Forestry stands. To the educated and governing class forestry means no more, but no less, than it meant to the same class in America scarcely fifteen years ago. Before the remarkably energetic and successful forestry educational campaign was undertaken only a comparatively few years ago by the Forest Service, how many graduates of American colleges and universities, how many members of either House of Congress, had a true and comprehensive, or rather even an elementary, idea of the principles, methods, and objects of technical forestry? How often are American foresters still confronted with that favorite question, "What is forestry?" To the great body of the more intelligent citizens just what does the term "forestry" still connote? To most it brings up a vague idea of "something to do with the forests—how interesting!" To others it is a branch of agriculture, or of botany, or perhaps it may mean some vague system of conservative lumbering. Since, then, forestry is still so imperfectly understood by the great body of educated Americans, who had opportunities for wide culture wholly denied to most Filipinos in the past, it is not surprising to find that a pro-forestry campaign must be directed towards all classes, and not merely to the simple and ignorant.

Even now, if Filipino autonomy goes no further,[3] the results of such a campaign are essential to any real and permanent success in forestry. The Assembly, or Lower House, of the Legislature is composed ex-

[3] The article was written before the passage by Congress in August, 1916, of the Jones Philippine Bill.

clusively of Filipinos. They also comprise a majority of the Commission, or Upper House. On the bench they are in the majority, and the Chief Justice of the Supreme Court is a Filipino. All justices of the peace and all prosecuting attorneys are Filipinos. One departmental portfolio is held permanently, and a second temporarily, by a Filipino. The Bureaus of Justice, of Labor, and of Lands are all under the direction of Filipinos, and in certain other bureaus there are Filipino assistant directors. Even in the other governmental activities directed by Americans the Filipino influence, direct and indirect, must be given very serious consideration. To the Bureau of Forestry, as to most other bureaus, Filipino support in the legislature, or at the very least the absence of strong Filipino opposition, is essential in securing progressive legislation and needed increases in authorized personnel and appropriations as well as for defense against inevitable attacks made from selfish motives, from misunderstandings, or from any of the other causes which find voice in the Philippine legislature as well as in the State legislatures and the Congress of the United States. The very existence of the Bureau as a separate entity—certainly the continuation, not to speak of the etxension, of its effectiveness—depends upon the attitude of the leaders of the Filipino people as interpreted through the legislature, the courts, and in co-ordinate bureaus of the executive branch of the government.

Under these conditions, it was long felt that an active educational campaign, waged patiently and tirelessly until success is attained, is absolutely essential to any real and permanent forestry work in the Philippines; but it was comparatively of only recent date that the Bureau's personnel and funds could in any real degree be detracted from the constructive work of essential organization to take up a propaganda long desired but necessarily postponed. The early foresters and rangers were engrossed in the pioneer work of making an inventory of the Islands' forest resources; in creating, even more than reconstructing (for the material at hand was lamentably small), the broad lines of organization on which the present and the future of the Bureau rest; in studying the people—their needs, their points of view, their psychology—and thus furnishing the data so essential for any popular campaign, but most of all in demonstrating to the people (which, after all, is the truest and most effective propaganda) the sincerity of their motives, the wisdom of their advice, the real meaning of their official acts, and theeir own tireless efforts to promote the good of the people among whom their adopted work lay. Privations, and even dangers (for one forest party was annihilated by the wild inhabitants of the

interior mountains), thus occasioned were borne by the field men as all in the day's work, and the record of these foresters, and no less of their Filipino companions and assistants, forms one of the finest pages in the history of any colonial administration. It has set a standard for their successors, who thus find their tasks of later years much easier, and who now are able to take up lines of work for which the way had been paved by their predecessors; to meet new conditions by building more elaborately on the foundations laboriously but cheerfully laid in the early years. It is such a development as this, made necessary by changing conditions, that it is the purpose of this paper to describe.

The average Filipino is far more docile, far more tractable, than the average American. I might almost say he is more reasonable; certainly he is more easily led. Undoubtedly he is more impressionable. Thus it is but reasonable to expect that the results of a pro-forestry propaganda in the Philippines, in proportion to time and energy expended, would be more promptly evident than similar efforts in America; and, other things being equal, I am convinced that such is true. But the law of compensation holds in this as in other matters, and if the forester in the Philippines is free from many handicaps with which his colleague in America has had to contend, he has his full share of his own peculiar difficulties.

Chief among these is the complexity of dialects. There is no common language in the Philippines. A knowledge of Spanish has always been restricted to a small educated class. The average Filipino, even in the city, speaks his own Malay dialect, and either knows no Spanish at all or merely a few dozen or score of the simplest and most ordinary words and phrases. The peasants in the fields and villages, the "monteses" in the hills, know hardly a single word. There are now more Filipinos who have a working knowledge of English than had ever possessed Spanish in an equal degree. But even this number is inadequately small, and is largely restricted to the younger generation, trained in the public schools since the American occupation, and to those government officials and employees who have found a more or less complete knowledge of the language a part of the necessary equipment for holding their positions. Other than these, the number of Filipinos who can read an English newspaper or circular is negligibly small. For the great, the overwhelming, majority of Filipinos a lecture must be delivered or an article must be prepared in their own dialect or not at all; and the number and complexity of such dialects is enough to discourage the most fervent enthusiast. Just what this number is, it is hard to say with any degree of accuracy. I have heard

it variously estimated at from thirty-odd to eighty. It is largely a matter of personal judgment to decide whether the speech of a given locality composes a distinct dialect in itself, or whether it is merely a variation, a "patois," of a neighboring one. While the number and disparity of the different dialects have undoubtedly been often exaggerated (they are all of Malay origin except that the Negritos, and even in any two of the most dissimilar at least 30 per cent of the words have a common root), still, taking the most conservative and optimistic view permissible, the fact remains that what is plain to the Ilocano, for instance, is utterly unintelligible to the adjacent Pangasinan—unless, of course, he happens to have acquired the dialect of his neighbors; and the same is true with the Pampango, the Ibanag, the Tagalog, the Bicol, the Cebuano, etc., not to speak of the numerous dialects spoken by the pagan tribes in the mountains throughout most portions of the archipelago and by the Moros and wild tribes in Mindanao and Sulu.

Next in importance, in numbering the difficulties, comes the matter of illiteracy. The majority of Filipinos throughout the archipelago can neither read nor write. Just what the true proportion is at present is not accurately known; but it is undoubtedly large.[4] Thus the circulation of newspapers and periodicals—the most obvious vehicles for an educational campaign—is small outside of the principal cities and towns, and if the mass of the people are to be reached, they must be approached not only in their own dialect, but *verbally*—in conversation and in public meetings. I think it will readily be admitted that these two factors in themselves present difficulties that might well discourage the newly arrived American forester, who in his previous work had always been able to take for granted, without a thought, the presence of these seeming requisites which are so conspicuously lacking in the Philippines. But these are by no means the only difficulties. I have already referred to the slow and unsatisfactory means of communication with many of the regions in which most forest users dwell, and to their inherited customs of forest abuse. And finally we have to bear in mind the inadequacy of the personnel at the Bureau's disposal and the pressing amount of other work which must be performed—duties which leave but little time available for an educational campaign.

---

[4] The Census of 1903 (Vol. II, p. 78) states that 55.5 per cent of the population over 10 years of age could neither read nor write; 24.3 per cent could read, but not write, and 20.2 per cent could both read and write. How much these figures have changed in subsequent years is difficult to estimate, but probably not enough to make any material difference for the purposes of this discussion.

A clear realization of the difficulties to be met is essential to the success of this, as of most other projects. That these difficulties are great cannot be denied, but the problems they involve are not incapable of solution. They are being met, successfully I hope, for it was felt that the work would be sure to bring about a clearer and more sympathetic understanding between forest administrator and forest user, not only in showing definite results in decreasing the number of forest infractions and in increasing just collections of forest revenue, but also in bearing a reflection in the attitude and policies of the legislature. Events have fully justified this optimism.

The simplest and most direct method of conducting such a propaganda is, of course, through the newspapers and other periodicals, and these are being used by the Bureau to the full extent permitted by their very strictly defined limits. While the audience thus gained is small in proportion to the entire population, it represents a very important fraction—the members of the assembly, the various officials, insular, provincial, and municipal, and the better educated and more influential class of private persons generally throughout the archipelago. It was realized that spasmodic efforts result in little or no real good, and that constant reiteration is the only thing that counts, and throughout the entire history of the Bureau the public press was used to the full extent permitted by the very inadequate funds and personnel with which the Bureau was forced to work. Later, when it became possible to undertake a systematic propaganda, it included an effort to have a reference, however short, to some phase of the Bureau's activities appear in every issue of every periodical; and although this ideal was at first, and still is, far beyond the means at our disposal, the best possible under the circumstances is being done. Most of the Filipino papers contain two editions—the principal one in Spanish and the second in the local dialect. Early in 1915 an appropriation was secured for the employment of an expert translator, who is thoroughly competent to handle Spanish and Tagalog, and as the various employees in the Manila office of the Bureau represent most, if not all, of the principal dialects, no great difficulty was encountered in translations. One of the most widely read and influential of the Filipino papers is "El Ideal," published in Manila, in Spanish and Tagalog, and the official organ of the Nacionalista party—the party which has a large majority in the legislature and other political circles. Here was published serially, in weekly installments, an adaptation and translation of Treadwell Cleveland's admirable circular on "What Forestry Has Done," under the more clumsy Spanish title of "Los Resultados Prac-

ticos de la Ciencia Forestal." The editor of the paper featured these articles on the first page, under the general heading, "Problema Fundamental." While this series of articles, and others along the same general lines, naturally appeal to only a small audience, they are distinctly worth while and have aroused no little discussion and comment. The Filipinos in their national aspirations are exceedingly anxious to be numbered in the vanguard of the more enlightened nations of the world, and these summaries of what other countries have done and are doing act as a very healthy stimulus to endeavor. Then, too, there are constantly appearing articles on special subjects of forestry interest, discussions of the economic importance of forestry in the Philippines, on the lumber industry, on the fuel supply, the export trade, the relationship of the mangrove forests to the fishing industry, etc., etc. Among the articles which carry much weight with Filipino readers are those written by Filipino members or supporters of the Bureau, and signed either by their true names or with a *nom de plume*. Whenever possible, Filipino officials, editors, and reporters were invited to accompany representatives of the Bureau to the Forest School to inspect the work there being done and to speak to the students, or to visit other activities in the near-by provinces. Such trips never fail to produce prompt and beneficial results. The Filipino reporter is as alert and as active as his American colleague, and the various movements and promotions of the different forest officers are duly chronicled in the daily press. Extracts from letters and articles from abroad telling of the advancement and achievements of forestry in other countries, of the activities of the different national forest services, of the foreign market for Philippine woods and other forest products—all these and many more of the same character were translated in Manila, mimeographed, and sent to the various periodicals throughout the islands, and perhaps partly because it is by no means an easy task to fill the pages of a periodical in the Philippine provinces, all such articles are promptly accepted and published by the editors.

But, as has been said above, newspapers and other periodicals reach only a comparatively small circle of readers. They are an important, but by no means an adequate, means for conducting an educational campaign. To reach the very much larger class who, while capable of reading, with more or less difficulty and imperfectly, their native dialect, seldom or never see a newspaper, several hundred thousand copies of a circular were printed and distributed throughout almost all parts of the archipelago. This circular endeavors to explain in a simple, easily understood manner the benefits which accrue *to the people*

themselves from the proper conservation and utilization of the public forest resources and the evils which must inevitably follow upon forest destruction. It points out that the forests are administered primarily for the use and benefit of the local inhabitants, who will be the first to reap the benefit of proper care and who would equally be the first to suffer the disastrous effects of waste and destruction. It is explained in a simple analogy that the Bureau of Forestry is not a police or purely protective organization to prevent the people from using the public forests, but rather an institution which exists solely to enable all the people, present and future, to derive the fullest and most permanent benefit from this very large and valuable public property. Next follows a concise outline of the privileges granted under existing forest law, and an equally clear statement of what is prohibited. Finally, all inhabitants are urged to get in touch with the nearest forest officers for more detailed information, and to report all violations which may be brought to their notice; and the circular closes with a list of all forest stations in the islands. The dialects and languages into which this circular has been translated and the number of copies printed in each are as follows:

Tagalog	71,200
Pampango	13,675
Pangasinan	19,250
Ilocano	42,975
Ibanag	7,700
Cebu Visayan	70,840
Leyte Visayan	34,500
Iloilo Visayan	56,550
Bicol	29,450
Spanish	5,150
English	10,000

The real difficulty came with their proper distribution, and to meet this successfully various expedients were adopted. A list of all municipalities and townships (nearly 1,000 in number) was prepared, showing the best obtainable estimate of the number of inhabitants and the dialects spoken. With this as a basis, the proportionate number of circulars and posters was mailed to the municipal "presidente," with a circular letter in Spanish asking him to use all practicable diligence to see that the circulars were distributed judiciously and widely not only in the "pueblo" itself, but in the outlying varrios or villages in his jurisdiction, and to have the posters nailed permanently and prominently on the public buildings and in various other points where they would attract the largest possible number of readers. Forest officers, in their trips of inspection, were required to observe and report upon

any failure to comply with this request. A circular letter to the same effect to all municipal presidentes was also mailed from the central government in Manila, and I wrote personally to each provincial governor and to each member of the assembly asking for his co-operation and influence. The good offices of the constabulary, both officers and men, were next requested, and cordially granted; and each constabulary station was furnished copies of the circular, in the proper dialects, for distribution by the regular patrols and otherwise throughout many isolated regions which are seldom or never reached by any other officials or employees of the insular government. All forest rangers are required to carry a number of copies on all field trips, and to distribute them wherever other methods have proved inadequate. Finally, most of the 10,000 copies in English were delivered to the Bureau of Education, which very kindly agreed to distribute them to every school in the Islands, the teacher in charge being requested to read and explain the contents to all the pupils and to paste up the circular for permanent reference.

There remains, however, the very large class of those forest users and Filipinos in general who are unable to read, and in reaching these newspapers, articles, and printed circulars are of no value, except perhaps in the case of those illiterate members of a family which contains one or more—children generally—who have had at least some slight educational advantages, and who can read aloud, more or less imperfectly, the contents of a written page. To get in touch with this part of the population several methods were devised. A short talk was prepared on the work and objects of the Bureau, following much the same lines as in the preparation of the circular previously referred to. This was mimeographed and a copy supplied to each ranger, with instructions to memorize it perfectly, and, translating it into such dialects as he might possess, to use it as the basis for public lectures or informal talks. It may be delivered verbatim, or else amplified and modified to meet local conditions or according to the individual ability of the speaker. As a matter of fact, such modifications are almost always made, and they continue to become greater and more effective as the rangers acquire greater practice and facility in public speaking. This is highly desirable for many reasons. The ranger's interest in the talks increases very largely when he feels that he is producing instead of merely repeating, and his talks carry an interest and a conviction that is impossible when he is merely speaking by rote. The instructions also provide that whenever a ranger, during the course of his regular field trips, finds that he will pass the night in a certain settle-

ment, he visits the municipal "presidente" or the "teniente del barrio," as the case may be, and asks him to arrange for a public meeting during the late afternoon or early evening. Notice is then sent to all the inhabitants of the town or village. In the larger settlements the municipal police are effective in spreading the news, and in the smaller towns, especially in the more outlying districts, the method known as the "bandillo" is employed. Half a dozen or so of men are sent out from the town hall equipped with a drum or other noise-making implement, and as the people flock around to learn the cause of the excitement a crier shouts out the object of the meeting and the time and place at which it will be held. Anything out of the humdrum routine of a monotonous existence is very welcome, and a good audience is very generally obtained. The head-man of the settlement is always requested to introduce the ranger, and the request is seldom refused. This secures the double object of giving a stronger shade of official color and of local authority to what the ranger will say, and at the same time it flatters the most influential man in the community and makes him more or less unconsciously arraign himself on the side of forest protection. The talks are always given in an informal, easy-going manner, and at the close the audience is invited to ask questions, to voice "reclamos" or complaints, or to argue any policy or acts with which they may not be in accord. It is not unusual for such gatherings to continue until nearly midnight. After such a meeting has been held forestry seems a more intimate matter, slightly more tangible to the people than hitherto, and the prestige of the Bureau and of the individual rangers takes a step upward. It would be easy to overestimate the practical importance of the results achieved. Unless such conferences are repeated with a fair degree of regularity their effects, or most of them, soon wear off and are forgotten. But at least each one does some good, and it is reasonable to expect that the aggregate result will be quite worth while. It is one of the few lines of endeavor which can be conducted without expense and without interfering with the other work of the rangers, as the meetings are held during hours which would probably not be otherwise officially employed.

Larger audiences, but probably less unbroken attention, are secured at the various fairs and "fiestas" which are frequently held throughout the principal provincial centers, and advantage is taken of every such opportunity that can be obtained. It is to be regretted that funds are not available to keep two or three speakers in the provinces devoting their whole time and attention to this work of propaganda, preferably supplied with portable moving-picture outfits, models, and other equip-

ment to catch and hold the interest and attenion of the crowds. The results would more than justify the expense; but for the present, at least, such plans must be consigned to the limbo of things hoped for.

Obviously, it is much too soon to attempt a complete summing up of the results obtained. Although the ground-work had been laid during many previous years, and much excellent work had been accomplished, a general, systematized, active propaganda was impossible until hardly more than a year ago, and one of the tests of its effectiveness must lie in the permanence of the results, and not in merely transitory success.

Viewing the situation as a whole, however, it seems that there is already clearly manifested good and substantial ground for a healthy optimism. The number of Filipinos in private or official life who have a clear understanding and appreciation of forestry is small, but it is appreciably larger than ever before. Another evidence that the efforts are bearing fruit is shown by the increasing frequency of editorials in the Filipino papers emphasizing and calling the attention of their countrymen to the importance of greater support to the cause of forest conservation; and it is shown no less by the scarcity of attacks in the local press, formerly by no means infrequent, upon the activities of the Bureau and its personnel. Letters to the Bureau from the assemblymen and from governors and other provincial officials show in general a cordiality and a spirit of sympathetic co-operation which are not found in similar communications of previous years, when the work of the Bureau was newer and less well understood. Never before have the provincial prosecuting attorneys, the justices of the peace, the judges, and even the Bureau of Justice, taken so firm a stand to assist the Bureau of Forestry by acting promptly and firmly to bring about the punishment of illegal forest destruction, in order that each conviction may prove a deterring example in the future. The forest charges are being collected more effectually and with fewer misunderstandings and complaints than at any time in the past, and the treasurers in the provinces and municipalities are showing a greater interest in and knowledge of this particular portion of their duties and a more cordial spirit of co-operation with the forest rangers.

But it is naturally in the Philippine legislature that the real test is to be looked for, and the most encouraging feature of the whole situation is to be found in the fact that here the success has been most conspicuous and most complete. While the Philippine Commission still held unshared legislative authority, and when a majority of its members were Americans, the Bureau had often a hard fight to maintain its integrity, its independent organization, and its popularity. But there

was never absent a small body of Filipinos and Americans who, though comparatively few in numbers, were strong in influence—men of wide vision, clear statesmanship, broad reading, and with a true patriotism of a high order—ready to support the Bureau. Although it is perhaps dangerous to mention any particular friends of the Bureau in past years, for fear of injustice to those whose names are omitted, it can do no harm to take this opportunity of paying a well-deserved tribute to Secretary Dean C. Worcester, to Secretary Winfred T. Denison (who succeeded him in the Department of the Interior), to the Hon. Jaime C. de Veyra (now Executive Secretary, but who as a member of the Assembly drafted and was largely responsible for the passage in the Assembly of the bill creating the Forest School), and more recently to Delegates Ruiz, Capistrano, Ocampo, and Romualdez and many others in the Assembly, and to Commissioners Ilustre and Palma in the Upper House. Ever since his arrival, in 1914, Governor General Harrison has proved an unswerving advocate for all that promotes the solidity of the Bureau of Forestry and the proper utilization and conservation of the forest resources of the Philippines. To these gentlemen and to many of their colleagues the admiration of all foresters is due. Without their constant and extremely influential interest the Philippine Bureau of Forestry might not exist today.

In striking contrast to previous sessions were the attitude and the acts of the legislative session which has just closed (February, 1916). It is true that in the first, opening days of the session the usual bill for abolishing the Bureau was introduced and referred to committee—from which it never emerged. Shortly afterwards a committee of assemblymen was appointed by the speaker to investigate all branches of the government engaged in work of an agricultural nature, with a view of recommending how their activities could be conducted more efficiently and economically. Although forestry is not agriculture, and should not, properly speaking, have been included in the scope of the resolution, we knew from past experience that the Bureau of Forestry would be so included, and all past experience also pointed to the foregone conclusion that the Bureau would be recommended for abolishment. The first of these apprehensions was justified. The Bureau *was* included in the committee's investigations; but not so with the second, for the report, as finally submitted in January of the present year, bore, we may be permitted to say, abundant evidence to the results which the "popularization campaign" of the preceding year had accomplished.

Although the report is too lengthy to incorporate in full in this article, one portion reads as follows:

"After a most careful and detailed consideration of the Bureau of Forestry, it is the firm conviction of your committee that now, as in the past, the suggestion to consolidate Forestry and Agriculture, either with the College of Agriculture or the Bureau of Agriculture, or in fact the suggestion to consolidate the Bureau of Forestry with any other branch of the Government, has arisen from a lack of definite appreciation or from a mistaken idea of what forestry really is, of the objects for which the Bureau of Forestry exists, and of the kind of work which the members of the Bureau are called upon to perform."

The report then proceeds to describe the work of the Bureau of Forestry, and adds:

"It is evident that in the carrying on of such work neither the Bureau of Agriculture nor the College of Agriculture plays any part whatever. Each of these organizations, as has been shown above, has its own objects to fulfill, and it could only result in a mutual loss of efficiency to combine two such different branches of the Government."

Referring to the proposal to merge the Bureau of Forestry in the Bureau of Lands, the report says in part:

"As the suggestion has also been made that the Bureau of Forestry be combined with the Bureau of Lands, your committee took occasion to investigate the advisability of such a plan. As a result, we find that the activities of the Bureau of Forestry are equally as distinct from the Bureau of Lands as they are from the Bureau of Agriculture. There is no duplication whatever, and the same considerations that argue against the combination of the Bureau of Forestry with the Bureau of Agriculture hold against the proposed combination of the Bureau of Forestry with the Bureau of Lands."

Referring to the Forest School, the report recommends:

"The time has come and passed when the permanent status of the Forest School should be established in order that the forest students may be given the training best to fit them for their forest work, and that such training may be given in the most efficient and economical manner. . . .

"Your committee strongly recommends that the Philippine legislature pass a bill separating completely the Forest School from the College of Agriculture and from the University of the Philippines, and organizing it as the Forest Academy of the Bureau of Forestry. The Director of Forestry should be *ex officio* dean of the Forest Academy."

Only those who have been through the battles of the past can appreciate how radical a change of sentiment such a report indicates, and

we who had the interests of the Bureau at heart took, I am afraid, a sardonic pleasure in the surprise and chagrin of those who had hoped to absorb it; and we feel that we are justified in the hope that it marks a permanent and real victory for the stability and expansion of the Bureau's policies for forest conservation in the Philippines. The fight most certainly is not over. There will be renewed attacks, new dangers; but at best some permanent progress has been made, and we have learned that the surest way to defend ourselves, in the Philippines as elsewhere, lies in taking the people into our full confidence—in making it possible for them to understand what we are trying to do and why, what forest conservation means to them and their children, and what would be the certain result of forest neglect.

But the changed sentiment of the legislature was not shown only in the report referred to above, important as that was in itself. Acting in accordance with its recommendations, the Forest School was separated from all connection with the College of Agriculture, and established as an independent school in the University of the Philippines, with the Director of Forestry as *ex officio* dean. The importance of this step can hardly be overestimated, as it insures without question our ability to shape the training and attitude of the future personnel of the Bureau. Theoretically, the school is maintained principally to furnish the Bureau with needed Filipino personnel. In practice this is its only function, for the Filipino student body is composed wholly of "pensionados" appointed by the Bureau, and whom the Bureau is under contract to employ when they graduate. Moreover, these graduates form the only source from which the ranger force can be recruited. Under such conditions it is obviously no more than just that the Bureau should have the control for their education, and of the attitude towards forest conservation and towards the Bureau which they receive during their studies.

Also, in spite of the necessity for rigid economy, the assembly passed, practically if not quite unanimously, a bill increasing the work and personnel of the Bureau; and this measure was made even more large in the Commission, and is now a part of the appropriation bill for 1916. Other special appropriations were also passed, first in the assembly and later approved in the Commission. These included an amount for completing a new central building for the Forest School and a sum for an entire new set of dormitories for the students. Notable also was the appropriation of ten thousand pesos to enable the Bureau to undertake the first reforestation project in the Philippines on more than a small or experimental scale. This work has now been started in the

island of Cebu. There was also passed a law conferring upon the Bureau certain long-desired authority in reference to mangrove swamps, pasture lands, and special uses in the public forests; and, most important of all, a new forest code was approved in February, which simplifies and codifies all existing forest legislation, and which, in many very important amendments suggested by the Bureau, puts Philippine forestry on a sound, scientific basis of which few countries in the world can boast.

In bringing about the results referred to above, it would be a mistake not to assign the full credit to the faithful work of the members of the Bureau in years past, but also to the campaign of propaganda by circulars, speeches, editorials, etc. The part that these agencies have played has undoubtedly been large, and has more than justified the thought and care and money that they cost; but they have not been exclusive. In its proper and broader sense the propaganda involved other agencies. Among these I attribute a very prominent place to an attitude by the members of the Bureau of almost extreme, unfailing courtesy and patience toward all forest users, to correspondents and to visitors, whether they be a peasant from the fields or the chairman of an important committee in the assembly. In my opinion, no other one thing brings such rich results in proportion to its cost in time and effort. I believe that this is true everywhere; but it is particularly true in dealing with an Oriental, who from his earliest cradle is brought up in an atmosphere of courtesy which the brusque Westerner is too apt to decry as "palavering" or to sneer at as an evidence of insincerity or duplicity. It may not be sincere—in many cases it most certainly is not—but even if it were reprehensible (which I most decidedly deny), it is a condition which confronts the forester as well as all others—a condition which has to be recognized if desired results are to be obtained. It is a not uncommon remark among foreigners in the Far East that the Oriental prefers a polite refusal to the discourteous granting of a request; and although, like most other generalizations, this is only partly true, still the truth of the attitude it indicates cannot be denied. The endeavor to be courteous should, of course, never be allowed to influence official decision; but it is by no means necessary that it should. If it is proper to grant a request, it can be done not only courteously, but the forest officer who grants it can show clearly that he takes a distinct pleasure in his ability to do so, and this without subjecting himself to the charge of insincerity. If it is necessary to refuse a request, it is generally, if not always, possible to state clearly and fully the reasons which necessitate the denial. At

most it requires only the addition of a paragraph or two to a letter, a few minutes added to a conversation, and the recipient or the visitor feels that his application has been given due thought and consideration. Most important of all, he feels that there is the *desire* to meet his wishes, provided that it were possible to do so.

During the nearly seven years I spent in the Philippines I have never found it necessary to "play politics" in the reprehensible sense of the expression, and I have found that courtesy, extreme courtesy, "palavering," if you will, is a most effective substitute. Courtesy, patience, complete and simple explanations, a scrupulous adherence to the truth, and a firm but tactful policy, which involves the punishment of misdeeds no less than the appreciation of proper work and behavior, will be found the only equipment (in addition to what may be taken for granted) the newly arrived forester in the East need bring to bear to assure his own success and the success of the work and of the ideals for which he stands.

ASPEN AS A PERMANENT FOREST TYPE[1]

By James M. Fetherolf

In Charge of Pocatello Nursery, Forest Service

In an article on the "Stability of Aspen as a Type," published in the January, 1916, issue of the Proceedings of the Society, the author seems to infer that all aspen is temporary as a type, but refers to the prevalence of a different view in District 4 from that held by himself. In presenting this other view, I intend to bring out the more permanent features of aspen as a type. The importance of a clear understanding regarding this from the management and forestation standpoints is admittedly great. Any information that may be supplied or stimulus added to research efforts will be valuable.

Aspen is admitted to be one of the most light-demanding species. In its eastern range, where the number of cloudy days is great and a large variety of trees are found which are mostly of larger size and greater shade endurance, this species is generally crowded out sooner or later and its re-establishment precluded, except when the more permanent species are destroyed by fire. Then, by virtue of excellent soil preparation, light seed widely distributed by wind, followed by prompt germination, aspen may gain possession of the ground and hold sway for a time, during which it acts as a nurse for the species creeping in to replace it. Thus aspen becomes a temporary forest type with prompt establishment, early maturity, and nursing as the leading rôles.

But to understand this species better, its behavior in habitats like the semi-arid intermountain region is of considerable value. This region, as well understood, is characterized by heavy snowfalls, by hot, dry summers, with an excess of sunlight, and topographically by great altitudinal range. With such strong contrasts the forest types are generally clearly defined and, on account of the fewer species, less complicated than in many other places.

Here the different cover types may readily be traced altitudinally on most any mountain range of considerable height. As a specific instance of clear typing, Boulder Mountain, embraced within the Powell National Forest in southeastern Utah, is cited. The mountain is capped by an extensive plateau 11,000 feet high. The rim of this breaks off

[1] Read before Intermountain Section, Society of American Foresters, December 4, 1916.

vertically for several hundred feet, whence the country falls away until the base is reached after a descent of 16 miles to the town of Escalante, 5,750 feet high. Around this truncated cone, as elsewhere in the region, the cover types occur in parallel altitudinal zones and stand out clear and well defined as listed from the lowest to the highest:

1. Sagebrush.
2. Cedar and piñon mixed.
3. Oak brush, coincident with the yellow-pine belt.
4. Pure aspen.
5. Aspen and alpine fir mixed.
6. Pure Engelmann spruce (on top of the plateau).

This is a typical example of the relative position of the types in which pure aspen lies between the brush or chaparral—yellow-pine type and the alpine conifers. Numerous other localities might be pointed out in which aspen shows its true relation to the other species and types; sometimes one conifer is more prominent, sometimes another, but aspen almost invariably occurs in pure stands at its lowest or first occurrence and more or less mixed with conifers at its upper limits, whence the conifers extend to altitudes where aspen cannot follow.

Examples of the occurrence of pure aspen considered permanent are found at the head of Gooseberry Creek, on the Fishlake National Forest, near the Grazing Experiment Station; in the park country on the Manti extending northward from Upper Joes Ranger Station to Bulger Canyon; near the Tony Grove Ranger Station on the Cache and on Cottonwood watershed on the Cassia Division of the Minidoka.

The writer holds that there is no conifer in the district with exactly the same requirements and qualities as aspen; hence there is left a strip or belt, as it were, in which no native conifer can replace it, with or without the help of a fire, just as there is a belt in which tree species cannot compete with sagebrush, with Engelmann spruce, or lodgepole pine, even though fires are prevalent. While aspen is considered as a *permanent forest* type in many places, it is admitted that it will alternate with alpine conifers in its upper limits where it mingles with them and the two overlap.

The main arguments in support of the permanency of aspen as a type outside of observation will be taken up briefly.

Aspen is a prolific sprouter. Whenever an opening occurs in any present stand, whether due to fire, old age, or accidents, it is promptly filled again by new root sprouts. As shown by clear-cutting experi-

ments at the Utah Experiment Station, in a few years the area restocks with a dense jungle in which the writer would hesitate to introduce the slow-growing conifers for fear that they would be smothered. In fact, heavy stands when underplanted there with conifers have to be thinned. Some years ago the writer had occasion to clear aspen-covered land for a nursery site, when the whole stand was found to be connected by superficial roots in which the smaller trees were joined to the next larger, and so on up the line. This proved the sprout origin of the stand. Throughout the district one repeatedly observes at time of flowering or leafing out that the staminate and pistillate trees occur in pure groups and patches, which would not be the case if the stands originated from seed. By virtue of this capacity for reproducing from root sprouts, aspen is practically independent of seed, and has this decided advantage over the conifers, whose seed occurs at irregular intervals, is eagerly sought by birds and rodents, becomes subject to drought before, during, and after germination, and to diseases, and is handicapped by slow initial growth.

Moreover, aspen leaves and litter harbor a fungus of the cobweb type, known either as Herpotrichia or Botrytis, which weakens and kills small conifers during winters in which the snowfall is very heavy. This affects natural seedlings as well as those resulting from direct seeding or planting. Aspen foliage may be a good shelter for such species as Douglas fir and Engelmann spruce during the hot summer months, but may become an agency for their destruction in winter or early spring. If we were to mulch our first-year nursery beds in autumn with a normal fall of leaves from a good stand of aspen, the chances are that all of the seedlings would be dead in spring.

Snow-shoe rabbits generally abound in the pure aspen as well as in the mixed and pure conifer types, but their influence is most keenly felt where the conifers are the scarcest. Thus, where the mixed type is approached, the few conifers that sift in and struggle along are frequently pruned back annually on top of the snow until they finally get above reach or, what is just as likely, until they succumb entirely. In case of plantations made in the pure aspen type, this drain upon the conifer supply becomes especially heavy and indicates what happens to natural seedlings that may get started and reach the attractive stage.

Whether attributed to drought, fungi, heavy shade, leaf cover, rabbits, or to the unfavorable site, the fact remains that the great majority of the plantations made in the type of aspen which the writer classes as permanent, even though successful for a while, eventually played out or died a lingering death, which argues against a natural rotation with the native species used.

Unquestionably fire affects conifer species more than it does aspen, due to the difference in methods of reproduction. It doubtless helps the latter to extend itself by stimulating its sprouting propensities. However, it does not follow that conifers could replace all aspen if fires were kept out. There is no proof that fires have been exceptionally numerous in the past; nor is the writer aware of any claim that fires have been more numerous in Utah, Nevada, and southern Idaho than in northern Idaho; yet the proportion of aspen to coniferous stands is very different in the two regions. Thus, in the timber estimates for Utah and Idaho forests, aspen is quite prominent; for the Fishlake it is placed at 52 per cent; for the Humboldt, 63 per cent, and for the Santa Rosa practically at 100 per cent. For the forests in northern Idaho the aspen stands are so insignificant that this species is usually left entirely out of the estimates.

By way of proving the proposition, examination and identification of charcoal specimens dug up in one particular locality, perhaps in the mixed type or near it, will likely be attended by errors in identification and in interpretation of results. Such data do not appear conclusive unless carried on in numerous localities and with numerous verifications. Moreover, charcoal in soil may not last longer than human memory.

It is generally admitted that trees of considerable size, like the native conifers, will occasionally, if not frequently, be uprooted. When this happens, a permanent mound of soil remains beside a depression or pit left by the roots of the falling tree and the soil removed by them. The trees thus literally erect their own monuments, as it were, and of a nature regarded by engineers as permanent. The writer does not remember noticing this type of evidence or proof in the pure aspen type.

As already intimated, a proper understanding of this matter is needed to formulate future management and reforestation policies. In so far as aspen is a permanent type, it should be considered satisfactory without underplanting. Should further experiments show that it is economically advisable to underplant it, such work should then be classed as "afforestation" instead of "reforestation" and the final result awaited with less certainty. Our present policy is one of suspense. Large forestation projects will not be undertaken in the aspen type until conclusive data can be obtained on the economic value of aspen as compared with conifers and until actual experiments with different species show whether a suitable one can be found for the purpose. After numerous failures with native conifers, it is likely that the greatest chances for success are with a foreign species, like Norway spruce. If any of the native conifers could hold its own as against aspen, it is presumed that it would be doing so now.

NOTES ON WHITE-PINE FOUR-YEAR TRANSPLANTS

By S. N. Spring

Professor of Silviculture, Cornell University

In 1913 three white-pine seedbeds (size, 4 feet by 12 feet) were sown broadcast with different quantities of seed. They received scant watering and minimum amount of care during the first and second years. The record at the end of that time was as follows:

Table 1.—*White Pine Seedbeds*

No. of bed	Amount of seed sown (*ounces*)	Average stand per square foot (*trees*)
1	12	180
2	10	110
3	8	90

Trees from each bed, respectively, were transplanted into rows 12 inches apart, with the trees spaced 1½ inches apart in the row. They received practically no artificial watering excepting during one short dry period and remained two years before removal.

The average height growth and percentage of mortality (based on 100 trees from each bed, which were in each case a part of a row appearing to be average) is as follows:

Table 2.—*Height and Percentage of Mortality of White-pine Transplants* (*2–2*)

No. of bed	Average total height (*inches*)	Mortality (*per cent*)
1	9.9	6
2	9.43	4
3	8.64	4

The number of trees in each inch class is interesting in relation to original density of the respective seedbeds. More exact experimenting is needed, these results being incidental to nursery practice; but the figures are at least suggestive. Tabulated, they are as follows:

[1] TABLE 3.—*Height of Four-year White-pine Transplants (2-2) by Inch Classes*

(Spacing, $1\frac{1}{2}$ inches by 12 inches)

Height, inches.	Bed No. 1. Number of trees or per cent.	Bed No. 2. Number of trees or per cent.	Bed No. 3. Number of trees or per cent.	Average of 1, 2, and 3.	Per cent by groups.
4	1	0	0	.33	10
5	2	2	4	2.66	
6	8	4	9	7.	
7	11	9	14	11.33	81
8	12	17	18	15.66	
9	12	20	27	19.66	
10	14	21	11	15.33	
11	13	13	11	12.33	
12	10	4	5	6.33	
13	7	6	0	4.33	9
14	3	3	1	2.33	
15	5	1	0	2.	
16	0	0	0	0	
17	0	0	0	0	
18	2	0	0	.66	
Total	100	100	100	....	....

[1] Height from ground to terminal bud. Table is based on 100 trees each from the Comstock Knoll Nursery, Department of Forestry, N. Y. State College of Agriculture, Cornell.

Summarizing the data in above table by height classes termed poor, average, and very good in quality, the following table is presented:

TABLE 4.—*Percentage White-pine Transplants According to Quality, Height, and Origin*

Quality class	Height class (*inches*)	Original beds: No. 1 (*per cent*)	No. 2 (*per cent*)	No. 3 (*per cent*)
Poor	Less than 6	3	2	4
Average	6 to 12	80	88	95
Very good	Over 12	17	10	1

An interesting fact ascertained from column 5, Table 3, is that 10 per cent of the trees are inferior for forest planting when the spacing in the transplant row is so close as $1\frac{1}{2}$ inches and the transplants are kept two years in the nursery. For producing four-year transplants a wider spacing seems necessary. Careful experiments along such lines as these are desirable.

DYING OF YOUNG PINES IN CIRCLES ABOUT ANTHILLS

By Ferdinand W. Haasis, M. F.

In 1914 Graves[1] noted a peculiar dying of white pine in pure stand. He considered it to be due to a specific fungus or group of fungi. He observed it in plantations of *Pinus strobus* near New Haven, Conn., and in other localities in the State, and reports it to have been seen by Professor J. W. Toumey in wild white pine 1 to 10 feet high in areas one or more rods in diameter near Conway Lake, N. H., and by others in New York.

W. O. Filley, State Forester of Connecticut, noted in 1915 that an anthill almost always occurred in the center of roughly circular blanks in his white-pine plantations on the Portland State Forest.

Graves[1] studied a white-pine plantation near New Haven, the trees being spaced 6 by 6 feet and having a height of 5 to 7 feet. This work extended over a period of three years, and he noted the successive dying of the trees in a circle of dead trees. This circle was 30 feet in diameter and increasing in size by the dying. A photograph accompanying the article plainly shows an anthill in the center. He mentions a yellowing of the leaves as a preliminary stage and describes the infection as "black pustules of some fungus" on the sunken bark of the tree affected at the base of the tree, "extending sometimes 3 or 4 inches from the ground." [2] Nine fungi, mainly species of *Fusicoccum,* were isolated from the bark of infested trees. Four spring inoculations of bits of bark were unsuccessful; but pure culture inoculations were in progress in 1914.

G. P. Clinton, Connecticut Agricultural Experiment Station Botanist, ascribes[3] apparently the same trouble to a species of *Phoma.* The disease resembles the *Einschnürungskrankheit* of *Abies,* due to *Phoma abietina* Hartig (= *Fusicoccum abietinum* (Hrtg.), Prill. and Delacr.), but the spores are somewhat different in shape.[4]

In a recent article Hawley and Record[5] discuss this dying, ascribing

---

[1] Graves, A. H.: "Preliminary note on a new bark disease of the white pine." Mycologia, VI, pp. 84-7 (1914).

[2] *Cp.* figs. 1, 5.

[3] Graves, A. H.: *Loc. cit.*

[4] Graves gives the following bibliography:
Hartig, R.: "Lehrbuch der Baumkrankheiten," ed. 2, p. 124, 1889.
Prillieux, E., and Delacroix, G.: "Travaux du Laboratoire de Pathologie Végétale." Bull. Soc. Myc. Fr. 6: 176, 1890.

[5] Hawley, R. C., and Record, S. J.: "Do ants kill trees about their colonies?" Am. For., v. 22, pp. 685-6 (Nov., 1916).

it to the ants, and report having found a red ant, *Formica exsectoides* Forel, in more than sixty hills studied in this connection at Ansonia, Middlebury, New Haven, Union, and other Connecticut localities, and in Pike County, Pennsylvania; and in one a black ant, *F. fusca* var. *subsericea* Say, which, however, is stated to be a host species of *F. exsectoides.* Occasionally ants were observed tending dark-colored aphids on trees near the hills of *F. exsectoides.* The trees involved exhibited a ". . . constriction of the trunk extending from 1 to 5 inches just above the ground line with a decided swelling at the upper margin. . . . The cambium layer is found to be girdled as by a canker, while the swelling above the injury is due to callous and continued growth of the stem in diameter for two years or so after growth below has ceased. Above the seat of principal injury is to be found a considerable number of small depressions in the bark which extend up the trunk from a few inches to two feet or more. . . . Instances have been observed where partially girdled trees have recovered." No outside evidences of girdling were seen. The conclusions the authors reach are as follows:

1. Ants are responsible for the damage.
2. It is probably not due to a fungus.
3. It is probably not due to mechanical injury, soil poisoning, nor damage to the roots.
4. It is to be combated by destroying the ants or by leaving unplanted areas about the ant colonies. The species involved was mainly *Pinus strobus,* but the following also were sometimes affected: *Betula populifolia, Hicoria ovata, Juniperus virginiana, Pinus sylvestris, Populus tremuloides, Quercus nana,* and *Rhus hirta.*

In the spring of 1915 the present writer was detailed to collect data on this problem in connection with other work on the Portland State Forest, Connecticut. It is through the kindness of Mr. Filley that this material is here presented for what light it may shed on the problem.

The following considerations presented themselves and were kept in mind during the study:

1. If this dying is due to a specific fungus (or group of fungi), it may be carried by ants or otherwise.
2. If carried by ants is it intentional or accidental?
3. Do the ants feed on the fungus or on the pine bark?[6]
4. Have ants been known previously to feed on fungi?
5. Have ants been known previously to feed on pine bark?
6. If ants carry the fungus incidentally, why do they visit the trees?

[6] *Cf.* p. 10 and fig. 2.

7. If ants do not carry the fungus, how is it carried?

8. Is infection merely secondary, following mechanical injury (*e. g.,* by ants)?

9. Are trees weakened by the presence of ants (*e. g.,* mechanical injury to the roots, by root injury due to associates of ants (aphids), chemical injury, modification of composition of soil water)?

10. If infestation is secondary, what is the primary cause?

R. Hartig[7] notes that it seems unnecessary that there be a mechanical injury to the bark of *Abies* before *Phoma abietina* Hartig can gain an entrance, that twigs are attacked, and that girdling can occur. According to Engler and Prantl,[8] there are more than 1,100 species of *Phoma* (Fr.) Desm (=*Clisosporium* Bon, *Sphæropsis* Lev. *pr. p., Gerulajacta* Preuss *pr. p., Coniothyrium* aut, *pr. p., Sporonema pr. p.*); *P. Pini* (Desm) Sacc occurs on fallen leaves of *Picea excelsa* in France; *P. pitya* Sacc on *Pseudotsuga* and *Pinus sylvestris* and *Pinus strobus, Phoma,* occurs in general on all parts of the plant except the leaves, but also on the leaves of *Coniferæ* and *Cryptogamæ.* Of *Fusicoccum* Corda there are more than 40 species; *F. abietinum* (Hartig) Prill. and Del. causes the *Einschnürungskrankheit* of *Abies. F. Pini* (Preuss) Sacc occurs on pine bark in Silesia.[9] *Phoma* and *Fusicoccum* are both classed in the same general group:[9]

Fungi imperfecti
- *Sphæropsidales*
  - *I. Sphærioidaceæ*
    - 1. *Hyalosporæ*
      - 2. *Phoma*
      - 29. *Fusicoccum.*

The *Fungi imperfecti* are spread by exogenously produced spores, Conidia. Underwood[10] notes *Phoma* as saprophytic.

At Portland ten anthills were observed in the 1908 plantations. Of these, six were surrounded by the blanks, while about the other four all the trees were living.

The disease as observed here was characterized on the living trees by elliptical reddish sunken areas (sometimes confluent), with a lenticel as center (fig. 1). Toward the ground these areas appear to be con-

[7] *Loc. cit.*
[8] Pflanzenfamilien I 1**, 1900.
[9] Engler and Prantl: *Loc. cit.*
[10] Underwood, L. M.: "Moulds, mildews, and mushrooms." 1899.

fluent, so as to include the entire bark, and sometimes what are apparently gnawed areas of about the same size. Such gnawing is frequently outside the rim of a small sunken area (fig. 2). On dead trees the bark

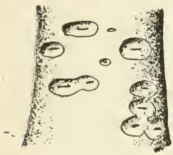


Fig. 1. Sunken areas on diseased living tree. nat. size.

Fig. 2. Gnawed areas on sunken infested bark of small living tree. nat size.

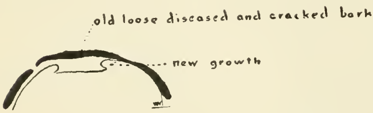


Fig. 3. Cross section showing formation of new bark on larger trees.

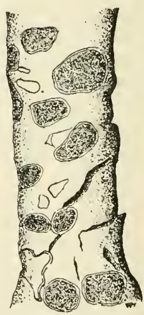


Fig. 5. Infected bark at base of tree. nat. size

Fig. 4. Scolytid galleries in wood. X2.

at base is sunken and much cracked (fig. 5), and there is present a species of Scolytid, or at least the galleries of the same. Some of the larger infected trees show a loose bark on one side inside which new growth is forming, as in case of a blaze or other injury.

Hill No. 1 contained black ants 6 to 7 mm. long. From specimens seen at the Experiment Station collection at New Haven this appears to be *Formica fusca* var. *subsericea* Say. The eight immediately[11] surrounding trees did not show the disease (*cp.* above), were not dying, and there were no ants nor aphids upon them.

Anthill No. 2 was the center of a circle of dead trees and contained ants 4 to 7 mm. long and with head and thorax red and abdomen black.[12] This is probably, judging from specimens at New Haven, *F. exsectoides* Forel. Six trees in the area were leafless and two had red leaves.[13] All of these showed the diseased areas (p. 5, fig. 1) and also the borings of the Scolytid beetle (fig. 4). Not far from here were three adjacent trees 10 feet high, showing the disease and the Scolytid work. Of these, two were red-leaved and one sorrel-leaved.[14] Of the living trees surrounding the anthill eight showed the disease and ant-gnawing; five the disease, but no gnawing, and eight neither disease nor gnawing. Of these twenty-one, none showed aphid infestation.

Anthill No. 3 contained the black ants of hill 1 (*F. fusca* var. *subsericea*). The surrounding trees were not dying. On this hill the black ants were observed fighting with the red-and-black ants (*F. exsectoides*).

Hill No. 4 was in a patch of sweet fern (*Myrica asplenifolia* L.) and contained red-and-black ants. The surrounding trees, 18 inches high, were not dying nor insect-infested.

Hill No. 5 contained the red-and-black ants. Within a radius of ten feet there were two living pines (two feet high) and none dead.

Hill No. 6 had red-and-black ants. Four adjacent pines were dead (with red leaves) and there was one blank where a tree had been. The bark of the dead trees showed signs of the disease. Three adjacent living trees were apparently fungus-infested, the bark at the base being sunken and reddened. Seven living trees near by did not show this. These trees were 1 to 2 inches in diameter at the base and 7 to 10 feet high. One living tree (one-half inch by 3½ feet, with a double stem) showed the reddened and sunken bark at the base and also gnawing. No ant-aphid infestation was seen on adjacent living trees.[15]

---

[11] Obviously and of necessity "immediately," without exact measurements, must be a somewhat arbitrary term.

[12] A third type of ant, 5 to 9 mm. long, and with black head and abdomen and red thorax, was observed associated with aphids on trees in low ground, but not in any of the hills studied. This seems to be *Camponotus herculeanus* L. or a subspecies or variety.

[13] These trees are loose in the ground (presumably because of shrinkage), and sometimes ants are rather abundant in the surrounding holes.

[14] This sorrel did not have stunted leaves. *Cp.* p. 8.

[15] This was observed on a day with brisk to high wind and there were few insects of any species on the trees.

Hill No. 7 was double, both *7a* and *7b* being rather small. The inhabitants were red-and-black. The nearest pine was 10 feet distant and its leaves were yellow. Eight of the surrounding trees were dead, three leafless and five with red leaves, and one had sorrel leaves.[16] All nine of these showed infection. The red-leaved trees have the living bark beetles, while the leafless trees show their galleries. In the sorrel tree this was not present and there was attempted healing (*cp.* p. 9 and fig. 3). Of the living trees (one-half inch by 2 feet to 2 inches by 9 feet) surrounding this area, 14 showed evidences of "Graves' disease" and six did not. No ants nor aphids were observed on the adjacent trees.[17]

Hill No. 8 was in a patch of bayberry (*Myrica carolinensis* Mill.) in a nearly pineless blank, 50 feet in diameter. The ants were red-and-black (*F. exsectoides*). There was one living pine (one-half inch by 18 inches) within 10 feet which was not diseased. Eight dead (leafless) trees within the area showed the disease and most of them the Scolytid work. These trees were one-half inch by 4 feet to 1½ inches by 6 feet. Two trees had red leaves, showed the disease, and had Scolytid infestation, the eggs being hatched. These trees were 1 inch by 5 feet to 1½ inches by 8 feet. One had spiral grain (left to right). A smaller red-leaved tree (one-half inch by 2 feet) also had Scolytid infestation, but might have been shade-killed. Of the adjacent living trees, one (2 inches by 6 feet) had the disease and an anthole (*F. exsectoides*) under the roots, but no ant-aphid infestation above; one (3 inches by 10 feet) had the disease to a slight extent, but no ant nor aphid infestation; 13 (one-half inch by 1 foot to 3 inches by 10 feet) had the disease and insect infestation, and 17 of the same size did not.

Hill No. 9 contained black ants and was the center of a 20-foot blank. Of the trees adjacent to the blank, one was dead and showed Scolytid infestation, but the disease was not evident. The others were living and only one (2 inches by 8 feet) showed the disease definitely, though there were some doubtful traces of an old infestation.[18] There was no insect infestation on these trees. Size, one-half inch by 2 feet to 3 inches by 10 feet.

Hill No. 10 had the red-and-black ants. It was the center of a 30-foot blank. Of the adjacent trees, nine (1 inch by 2 feet to 2 inches by 10 feet) were dead, all showed the disease, and at least eight had the

---

[16] Leaves of sorrel-top trees are a pale yellow green in color, reddish toward the tip, and 1 to 1½ or 2 inches long.

[17] Might be present on a day with less wind.

[18] *Cp.* below and fig. 3.

Scolytid work. Four (1 inch by 4 feet to 2 inches by 10 feet) had red leaves and showed the disease and Scolytid work. Of the adjacent living trees, one (one-half inch by 2 feet) showed the disease: split bark with attempted healing, considerable resin being present at the wound. Ants were rather abundant on the ground about this tree. Of the others (1 inch by 4 feet to 3 inches by 10 feet) twelve showed the disease and six did not. Ant-aphid infestation occurred on two of the diseased trees. There was gnawing on six of the diseased trees, two of these being the ones with ant-aphid infestation. On another tree there were no ants nor aphids and the disease was doubtful, but the bark was checked into plates (fig. 5) and gnawed areas occurred. Size, 2 inches by 10 feet. Old disease scars have been included in the above, as larger trees show a tendency to recover; but if a specific fungus is concerned such trees could serve as centers of infection.[19]

The red-and-black ants (*F. exsectoides*) were observed gnawing the bark of a diseased tree.[20] Filley also reports having seen ants feeding at the base of a dead tree in one of the blanks. The red-and-black ants were far more ready to fight in or near a hill than on trees (among the aphids) or in the collector's net. They were quite commonly associated with an aphis on pines of various sizes.

The following tabulations show in detail the condition of the trees about the ten hills studied.

[19] The ants were exceptionally vicious about this hill.
[20] *Cp.* fig. 2.

Red-and-black ants (*Formica exsectoides*)

Hill No.	Dead.	Condition of trees.						
					Living (green) leaves.			
		Red leaves.	Yellow leaves.	Sorrel leaves.	Disease, gnawing.	Disease, no gnawing.	Disease, ant-aphid.	Normal.
2	6 *†	2 *†	.....	......	8 ‡	5 ‡	......	8
		2 *†°	......	1 *†°	......	......	......	......
4	......	no	dying.		......	......	......	......
5	......	no	dying.		......	......	.....	2
6	.....	4 *	......	......	1 ‡	3 ‡	......	7
7	3 *†	5 *†	1	1 *††	......	14 ‡	......	6
8	8 *†	2 *†	......	......	......	......	......	1
		1 †‖	......	......	......	2 ‡‖	13 ‖	17 ‖
10	8 *†	4 *†	......	......	......	1 ††	2 x	......
	1 *¶	......	......	......	4 ‡	6 ‡	......	6
					1 ‡§	......	......	......

Black ants (*Formica fusca* var. *subsericea*)

1	......	no	dying.		......	......	......	......
3	......	no	dying.		......	......	......	......
9	1 †	......	......	......	......	1 ‡z	......	several.

* Disease. † Scolytid work. ‡ No aphids. ° Cp. p. 6.
‖ Cp. pp. 8–9. †† Healing. x Gnawing.
§ Disease doubtful; gnawing. ¶ Scolytid work doubtful.
‡z Possibly more (old).

F. exsectoides		*F. fusca* var. *subsericea*	
dying	no dying	dying	no dying
5	2	1	2

To sum up:

1. The phenomenon is associated with anthills.

2. There are generally involved fungus and Scolytid infestations.

3. It may be exhibited about hills of both *Formica exsectoides* Forel and *F. fusca* var. *subsericea* Say.

4. Hills of both the species of ant may occur among the pines without the damage resulting.

5. It occurs in both plantations and wild stands.

The evidence afforded by these data indicates:

1. That the trouble is probably due to fungus.

a. The constricted and apparently diseased area is quite characteristic. Graves considered it diseased.

b. Graves isolated from these areas nine species of fungi.

c. The trouble apparently originates at a lenticel.

On the other hand, we have the negative results of bark inoculations. (The pure culture inoculation results are not available.) Hawley and Record consider it as not due to a fungus, but fail to account for the bark constriction.

2. Ants are probably connected with the spread of the disease.

a. It has not been noted except in connection with anthills; but anthills do occur without the damage being present.

b. Ants do feed on the bark to a certain extent, but whether or not the fungus is carried at this time is uncertain. Often gnawing is not evident on affected trees, and the amount observed is so slight that this would seem to be a minor factor. Possibly a fungus could be carried by ants bearing aphids to the tops of the trees or visiting them there, though this would not explain the localization at the base of the infected tree. Infection may be secondary, but it is to be remembered that this is believed not to be the case with infestations of *Fusicoccum abietinum* (Hrtg.) Prill. and Del.

3. Another factor involved is the Scolytids. These, however, are apparently secondary invaders, having been observed in dead and dying trees, but not in living diseased trees.

Taking up the queries suggested on pages 3 to 4, as a whole, no definite answers can be given:

1. The disease is apparently due to a specific fungus or fungi.

2. It is doubtful that it is carried intentionally by ants.

3. It cannot be said that the ants feed upon normal bark rather than upon fungus-infested bark.

4, 5. No memorandum has been found of ants feeding on fungi or pine bark aside from the observations presented above.

6. Possibly ants tending aphids on trees can carry the disease, though on the majority of diseased trees no aphids were present. Still they might have been moved after infection.

7. Unless the Scolytids are concerned, we have no data tending to show how the disease could be carried except by ants.

8. Infection seems to be primary. It might, however, follow Scolytid injury.

9. There is no data on this point.

10. The answer to this is involved in the above.

REVIEWS

Public Domain Commission, State of Michigan. Biennial Report 1914-1916. Lansing. 1917. Pp. 179.

Consolidation of State commissions is the order of the day. The Public Domain Commission of Michigan, created in 1909, composed of six *ex officio,* unpaid members, elective State officers, has gradually absorbed not only public land interests, including forest reserves, but all forest interests, game, fish conservation, and immigration.

The recital of legislative acts defining the functions of the commission occupies 17 pages of the report. From all appearances, Michigan, after thirty years of propaganda and slow development, seems to have made a start in good earnest to develop a sound and adequate State forest policy, for which the preceding Forestry Commission, since 1903, had laid a good foundation.

It appears that the commission is empowered to create forest reserves and had by July, 1916, including previous reservations of 40,000 acres, set aside 236,460 acres of forest and non-agricultural lands in 57 parcels, and the powers are broad enough to insure a general conservation plan for the State, with authority to reforest, protect against fire, etc. Eventually it is expected that the 600,000 acres owned by the State will be in reserves, or are virtually now so held. Appropriations have grown until for the years 1916 and 1917 they amounted to $220,000. A detailed financial statement analyzed from various points of view covers 16 pages. In this the present forest reserves appear valued a little over $500,000, to which personal property, amounts collected for dead and down timber, and for trespass, of altogether $118,000, are added, while the total cost of expenses to 1916 is stated as $464,000.

To the general report of the commission there are added various contributions from its officers. Under the title of "Encouragement to reforest private lands," for which the commission furnishes seedlings, a tax release act, known as woodlot exemption act, passed in 1911, is printed, and a useful compilation of tax exemption conditions in other States is added, covering 20 pages.

This legislation resembles the Pennsylvania act in that it provides for private forest reserves, but it is peculiarly foolish in making 170 trees, *original* or *planted,* the basis of the benefit; various other conditions appear silviculturally unsound, such as the limitation to a cut of

only 20 per cent of the number, such as admitting mulberry, osage orange (in Michigan!), sassafras, and catalpa as satisfying the law. The benefit consists in valuing such reserves at not more than $1 per acre for tax purposes.

A nursery of 12 acres furnishes plant material for State work and for sale to private planters.

The report of the State Forester, Mr. Marcus Schaaf, rehearses briefly what had been accomplished by the old Forestry Commission and the slow beginnings of the new commission, and gives brief descriptions of a number of State forests. Considerable space is given to forest protection. We note as a special feature that there seems much reliance placed on the efficiency of fire lines, of which the old commission had constructed 64 miles and the commission had brought up the mileage to 338; this for an acreage of about 110,000 acres; the cost in later years having varied from $52 to $90 per mile. There is no statement of the cost of maintaining these fire lines, but we are inclined to think that in proportion to their effectiveness the expense may prove excessive, since they are twice or three times during the season cultivated by disc-harrow or other cultivator, with a view of exposing mineral soil and of preventing the growth of grasses and weeds. While in the pineries such lines may be made effective at relatively low cost. The fire lines form, to be sure, convenient lines of subdivision, being located on section and subdivisional lines, and form convenient lines of defense in fighting fires as well as in utilization. Privately we are informed that with modern tractors now used the cost of maintenance and even of construction is not great. Once going over with machine and two men will suffice each year and costs less than $5 per mile. On sand plowing and disking effectively keeps growth down. In hardwoods it is advocated to leave the grass to grow and mow or graze it. Eight steel towers for lookouts and 33 miles of telephone lines make patrols in those parts where they are installed unnecessary, nevertheless the value of patrol work to prevent the starting of fires by campers, berry pickers, fishermen, hunters, and other careless people is recognized.

In the report of the Game, Fish, and Forest Fire Commissioner the interesting point is made that by the sale of licenses all expenses, including salary of commissioner, are covered, apparently including the fire protection. It is notable that "there is no other State which shows so small a rate of forest fire loss for the comparatively large slash area as that reported for Michigan during the years 1912-1915." A complete record of fires for 1916 is appended.

An article by Mr. J. G. Peters, of the U. S. Forest Service, explains the working of the co-operation in fire protection by the Federal Government.

That the report is more than paper talk, but is based on actualities in the field, is attested in a brief communication by Professor Roth, who for so many years has labored himself to commit the State to the present policy. There is nothing but praise in his letter, and "praise from Sir Hubert is praise indeed!"

B. E. F.

Forest Life and Sport in India. By S. Eardley-Wilmot. Edward Arnold: London. Second Impression, 1911. Pp. 324; 2 maps.

No one who reads this authoritative book, from the pen of a former Inspector General of Indian Forests, can be insensible to the charm of the forest life and sport from the Andamans to Kashmir. To one who has perhaps sickened of "desk-sergeant forestry" it is refreshing to learn that in a life service extending over thirty-five years "some seven months of each year had been spent"—(*in the field*)—"in laying up stores of experience and local knowledge." The spirit and impression of Indian Forest Service radiates from every page.

Interspersed with the interesting accounts of shooting and tours there is much to interest the forest administrator who looks beyond the mere routine of red tape.

Few people think of India as extending from within eight degrees of the Equator to regions of perpetual snow, which occurs at elevations of over 16,000 feet. For this reason, and because of the importance of agriculture, which is usually dependent upon irrigation, the preservation of a forest cover is essential to the economic future of the nation; and, unfortunately, most of the important rivers rise in regions that are *not* owned by the British Government, so that the conservative treatment of the area that *is owned* is all the more vital.

It is clear that the future development of Indian forest wealth will be chiefly along two lines:

1. Development of hydro-electric power. In a country where it is abundant and where fuel is scarce and expensive the lack of available capital for the development of this resource is unfortunate.

2. Use of forests for paper pulp. Under present conditions most of the spruce and fir is used for fuel (or occasionally timbers), whereas its natural economic use is for paper.

Yet those who look to India for timber to ward off a world famine

should not overlook the increasingly insistant demands of the local population. *Little will be available for export beyond teak and ornamental woods,* aside from paper pulp and tannin extracts. For, as Eardley-Wilmot points out, the objective of Indian forestry should be: "To supply the requirements of its population in forest products, to protect the water supply of the country, and to afford help in its industrial development." In the past perhaps too much stress has been laid upon the financial success of forest management and a happily phrased note of warning is sounded: "As in the case of European countries, the forest management should, as it always has, result in profit, but this profit should be subsidiary to the main objects in view. . . . The estimates of reliable and experienced experts are vain if it is insisted on that an increased revenue should precede an increased expenditure. . . ." A lack of sufficient appropriations for needed improvements thirty or forty years ago clearly resulted in the retardation of forest development and in the loss of efficiency of the personnel, even where sickness and death did not result because of unsuitable quarters in a tropical country.

Perhaps the greatest task which fell on the shoulders of Eardley-Wilmot as Inspector General was the betterment of the pay of the superior force, whose efficiency and integrity could be best secured by a salary commensurate with the social rank to be maintained. To reduce the salary below this point must be a danger point in colonial administration. "An eminent Viceroy once expressed horrified surprise that every public service in India was pressing for better conditions of service; the mental shock might have been softened had he recalled Becky Sharp's remark that it is easy to be honest on 5,000 pounds a year." . . . !

It is something to succeed in forest administration anywhere, but think of the difficulty of succeeding with a tropical climate and the people of the Far East as permittees! Let's doff our hats to Eardley-Wilmot and his coworkers.

T. S. W., Jr.

Shade Trees: Characteristics, Adaptation, Diseases, and Care. By G. E. Stone. Bulletin 170, Massachusetts Agricultural Experiment Station. Amherst, Mass. 1916. Pp. 264.

This is more than a popular treatise; indeed it is an unusually complete, all-comprehensive publication on a subject on which lately much has been published. The author, for many years connected with the

Massachusetts Agricultural College, can be trusted to give thoroughly reliable and wise information without much unnecessary language, parts being naturally compilation and some parts based on personal investigation.

While this is a subject which only distantly interests a forester, there is much in the book that he can read with benefit regarding tree life in general. We will only refer to the very sane position the author takes in discussing the question, "What shall we plant?" which in view of the pine blister rust, the chestnut blight, and other specific pests, most unusual weather conditions in the last few years included, has a bearing on forestry practice. "Notwithstanding the fact that some trees have suffered particularly from various causes," the author says, "we believe that these should still be utilized for planting. . . . Moreover, affection by insects and fungus disease must not always be considered too seriously in judging the value of a species, since control of many of them is possible with the use of modern methods. It should be borne in mind that many of the pests are secondary or are subservient to other causes." Thus the author considers the borers which have been killing the cut-leaf birch secondary to drouth injury, which can be prevented. The leopard moth injury to elms, as well as the elm-leaf beetle, is considered secondary, and even the chestnut blight is held by competent pathologists secondary to some other cause or deteriorating factors, as the death of numerous chestnuts without a sign of blight lead to believe. Suitable soil conditions are in many cases preventive of damage, and soil texture plays probably the most important part in all tree development, producing also different types of the same species.

The chapters on winter-killing, sunscald, drought, and more especially the effects of illuminating gas and electricity, are based in part on personal investigation, and hence are specially valuable.

No two species of trees suffering from gas poisoning present precisely the same symptoms, and there is much difference in the same species, the location, season of the year, and other factors having an important modifying effect.

The action of direct and alternating currents and the conditions under which damage occurs are carefully analyzed. Alternating currents, employed for lighting purposes, are more frequently injurious because of higher potential and more leakage; but low voltage (110-volt) lines are no causes of injury whatever, the cited judgment of a court notwithstanding. The high voltage injury is local. The general effect of the direct currents (electric railroads) is also mostly local,

confined to the contact with the wires when the tree is moist. But instances are known in which large trees have been killed by direct current, and several authentic cases are cited.

In this country every forester is expected to be a general "tree sharp," and here is an opportunity to secure reliable basis for his sharpness, which we can unreservedly recommend.

B. E. F.

Factors Influencing Transpiration.

Transpiration as a Factor in Crop Production. By T. A. Kiesselbach. Agricultural Experiment Station, University of Nebraska, Research Bulletin 6. 1916.

Hourly Transpiration Rate on Clear Days as Determined by Cyclic Environmental Factors. By L. J. Briggs and H. L. Shantz. Journal Agricultural Research, Vol. 5, No. 14, pp. 583-649. 1916. This was not published until after Kiesselbach's work was completed.

Relative Water Requirements of Plants. By L. J. Briggs and H. L. Shantz. Journal Agricultural Research, Vol. 3, No. 1, pp. 1-63. 1914.

Transpiration is the simplest and most readily measured plant activity reflecting the conditions under which plants grow. It is therefore of great value in studying the effect of environmental factors upon plants, and is one of the means by which we will eventually secure the knowledge we require as a basis for forest experiments. Kiesselbach has investigated transpiration and the factors influencing it in a way which is not only suggestive, but gives results of considerable importance.

The study covers the relation of transpiration to climate, to soil moisture, and to soil fertility, as well as the effect upon transpiration produced by growing first in a dry and then a moist atmosphere. Much quantitative, and hence definite, data was obtained under each of these headings. Although the work was done with field crops, chiefly corn, the broader results apply to all vegetation.

Under the relation of transpiration to climate, Kiesselbach measured the transpiration of good-sized corn plants growing in large cans, while he kept records of evaporation from a free water surface, of temperature, of relative humidity, and of wind velocity. The resulting charts (pp. 98 and 99) show that transpiration paralleled evaporation more closely than any of the other measured factors. Since he did not record the solar radiation, his results are not in disagreement with Briggs and Shantz's conclusion that solar radiation is the primary climatic factor

controlling transpiration, and that evaporation coincides with transpiration more closely than any of the remaining factors. The reason is, of course, that evaporation is itself dependent on the forces affecting transpiration (solar radiation, temperature, relative humidity, and wind), though not in exactly the same way. Transpiration virtually ceases at sunset, while evaporation diminishes more gradually.

A low rate of evaporation causes greater economy in the use of water by the plant—that is, in a humid climate the plant uses less water per gram of dry weight and of ash produced than in a dry climate. Similarly a moist season will result in considerably greater economy of water than a dry season. Briggs and Shantz had already shown this in their water requirement studies at Akron.

The effect of soil moisture on transpiration (charts on pp. 103 and 104) is one of the most interesting parts of the investigation. It was found that transpiration was greatest at the optimum water content. Too much water, contrary to expectations, decreases transpiration, sometimes even below that shown by the low water content. Kiesselbach also shows (p. 140) that with a low soil moisture the plant uses a little less water per gram of dry matter, of grain, and of ash produced, but that the total yield with the low soil moisture is about a third less than with the optimum moisture content. With an excess of water the yield was reduced almost as much as with a deficiency of water, and the plant used more per gram of dry matter produced than with optimum water conditions.

Soil fertility has a distinct effect upon the water requirement, a good soil causing the plant to use more water by making it more vigorous, but causing it to yield more; so that actually on the good soil the plant uses less water per unit of dry weight produced than it uses on a poor soil. Thus the poor soil allows less water to be drawn out; but, since it permits the plant to make less with the water used, is more wasteful of water than a fertile soil. This is a matter of considerable importance in explaining some of the forces underlying competition on different soils. Certain soils are fertile to one tree and infertile to another; the tree to which the soil is infertile will use water less economically than the other tree, and will therefore be at a disadvantage for water as well as for nutrients.

Of considerable interest in reforestation is the experiment on the influence of a change in the relative humidity upon transpiration. Kiesselbach grew two sets of plants in greenhouses for eight weeks, one set in dry air, the other set in moist air. Those in the dry air showed a markedly higher rate of transpiration than those in the moist

air. Then he changed some of the plants about to see what effect the previous environment would have upon transpiration. He found practically no effect. The plants which had been growing in a moist atmosphere, as soon as placed in dry air, behaved just like the plants which had grown in the dry air right along, and *vice versa*. This would seem to indicate that in forest nurseries in semi-arid regions there is no use in trying to acclimatize the young trees by leaving them with very little water, as has sometimes been advocated. It would be well, however, before accepting this conclusion, to try an analogous experiment covering a period considerably longer than eight weeks.

The foregoing are but a few of the more important results of Kiesselbach's research. His bulletin contains much else which will not only repay careful perusal, but make the publication one to which forest investigators can constantly turn for helpful suggestions.

Barrington Moore.

Department of Conservation and Development, State of New Jersey. Annual Report for the year ending October 31, 1916. Pp. 84.

As long as 40 years ago the State Geologist of New Jersey included the forestry interests of the State in his annual reports. In 1904 a Forest Park Reservation Commission was instituted, and in 1915 six State commissions were amalgamated into the Department of Conservation and Development, Mr. Alfred Gaskill, the State Forester, becoming also the director of the department, under a board of eight commissioners, the department being divided into three divisions, namely, of geology, of forests and parks, and of waters.

Mr. Gaskill, on account of ill health being on leave of absence, the section of the report dealing with the State Forester's work, as well as that of the State Fire Warden, is made by the latter, Mr. C. P. Wilber. A very brief statement of activities of the department as a whole and the Geologist's report occupies over one-half of the volume.

Although the State now owns over 15,000 acres of forest reserves, the activities of the State Forester even on these reserves are largely educational. This attitude is explained by the statement that "forestry in the State undoubtedly will long remain a problem of the private owner in large part," and the regular employment of a forester by most owners is excluded on the mere woodlots into which the 200,000 acres of forest land seems to be divided. This may be true for the northern part of New Jersey; but in the southern section there appear, by the statement of the department itself, extensive enough areas to

institute State reserves with economic management in view. Indeed, the Stokes Reserve, in the northern part, with nearly 7,000 acres, should also lend itself to such management as a unit without losing its recreation value, which is accentuated as representing the special value of the reserves outside their demonstration value.

From a business point of view, the report is faulty in not giving any statement of budget and detail disbursement, which would give an insight into the cost of the service.

This fault is not to be found in the State Fire Warden's report, which carefully analyzes the detailed statistics of number of fires, usefully divided into larger and embryo fires, of acres burnt, loss, cost of extinguishing, and allotment of charges to townships, State, and offenders. It appears that 292 forest fires and 317 embryo (below five acres) fires burned over 51,654 acres, causing a loss of $69,000 and requiring an expenditure of $7,223, of which $2,063 could be recovered from offenders, the balance nearly equally divided between townships and State. An analysis of causes leads to the interesting conclusion that physical conditions are not the only, or indeed the major, factor, but that personal, not climatological, conditions are responsible for the majority of fires. Locomotives still are the most frequent cause (38 per cent). Statistical proof is brought, however, that matters are improving with improved organization.

B. E. F.

Die Härte der Hölzer. By G. Janka. Mitteilungen aus dem forstlichen Versuchswesen Österreichs, No. XXXIX. Vienna. 1915. Pp. 114.

Janka, whose tests of hardness were described in Forestry Quarterly, Vol. VII, 101, has used as a measure of the hardness of wood the power that is required, expressed in kilograms, to press a steel hemisphere having an area of one square centimeter on its flat surface into the wood to a depth equivalent to the radius of the hemisphere, or 5.642 mm. This is accomplished through the use of the standard Brinell apparatus. The impression is made on a smoothened section of the wood that is parallel with the wood fibers. He makes the following classification:

I. Very soft wood, power required less than 35 kg/cm.^{2}
II. Soft wood, power required from 351 to 500 kg/cm.^{2}
III. Medium hard wood, power required from 501 to 650 kg/cm.^{2}

IV. Hard wood, power required from 651 to 1,000 kg/cm.^{2}
V. Very hard wood, power required from 1,001 to 1,500 kg/cm.^{2}
VI. Bone hard wood, power required over 1,500 kg/cm.^{2}

The test specimens were rectangular pieces 2.5 cm. in thickness, selected from the pith to the bark. Nine impressions were made in each specimen to obtain a fair average. The tests were made in vacuo, and the moisture content of the specimens varied between 10 and 16 per cent. Two hundred and eighty-six woods were tested, classified by Janka as follows: *a*. native hardwoods, 128 species; *b*. native conifers, 23 species; *c*. foreign hardwoods, 122 species; *d*. foreign conifers, 13 species.

Determinations of dry weights, specific weights, bending strength, and shrinkage were also made, and from the results Janka arrives at the following conclusions:

1. The higher the specific gravity of wood, the greater the hardness.
2. The higher the specific gravity of wood, the greater the strength.
3. The higher the specific gravity of wood, the greater the shrinkage.

Three comprehensive tables give the results of the tests in detail.

B. L. G.

Province of British Columbia. Report of the Forestry Branch of the Department of Lands for the year ending December 31, 1916. Victoria. 1917. Pp. 35.

The first point that would strike the reader is the entire impersonal character of the report. It does not appear over anybody's name; only the title page bears the names of the Minister of Lands and of the Chief Forester, M. A. Grainger, in smaller type; the transmittal to the Lieutenant Governor is made by the Minister.

The next point that would strike the reader is the purely administrative and business character of the document, without much argument or propaganda discussion, and the large amount of tabulations.

It is a significant feature for a forest-service report to start out with an account of the efforts of the Forest Branch to extend the lumber trade of the Province. A very well-conducted systematic campaign to increase the market for British Columbia wood products in the Eastern and Prairie provinces has been carried on; in the Eastern provinces by establishing a lumber commissioner at Toronto with an exhibit of British Columbia products to educate architects, engineers, and contractors to the value of these products; in the Prairie provinces by distributing over 200,000 bulletins, giving descriptions and specifications for various

farm buildings. Extension of offshore markets could not be worked for on account of lack of shipping tonnage.

The war needs of the mother country, for boxes especially, in 1915 had brought the export figure to 58 million dollars, but in 1916 it had dropped to less than 44 million. To secure preference in the British colonies, such as has brought the African export from 30 per cent in 1904 to 88 per cent in 1916, is advocated for the future.

The timber industry for 1915 is credited with around 675 million feet of lumber, which by translating minor materials into board feet is increased to nearly one billion feet. In this translation poles and piles are assumed at 5 feet per lineal foot; railroad ties, 30 feet; fence posts and mine props as containing 500 feet per piece.

In value this cut is estimated at 29 million dollars, while the 1916 cut, around 1.3 billion feet, is valued at 35.5 million dollars.

The various leases and licenses under which the cutting on crown lands is done are classified in eight classes. Douglas fir and red cedar, with some hemlock, furnish the bulk of the cut, all other species together amounting to about 25 per cent of the total.

In the timber sales, some 136 million feet, the stumpage price ran from 39 cents to $1.95 per thousand for the several species, averaging only 96 cents.

The total revenue from all sources was slightly increased over the previous year, but remained one-third below that of 1913, amounting to a little over 2 million dollars.

The expenditure allowed amounted to a little less than $338,000, to which is to be added a forest protection fund of $150,000. Of this, $85,000 was used in investigations and in encouraging of the lumber industry; but the actual administrative expenditures are expected to remain $80,000 below last year's.

The forest protection fund was organized in 1912, the timber limit owners contributing 1.5 cents per acre and the Government a like amount. For the first two years this was sufficient allowance, but the bad season of 1914 necessitated an additional advance by the Government of $143,000, which by economies effected in 1915 and 1916 was repaid.

The detail of expenditures from this fund are tabulated.

The force of the Forest Branch has been considerably reduced due to war conditions. The permanent staff is reduced from 190 in 1914 to 163 in 1916; the temporary force from 558 to 336. The total land area involved being 150 million acres, the ranger districts average now near 5 million acres; the guard districts nearly one million.

There are nearly 14,000 licenses in good standing or reinstatable, but the annual expiration in the last three years has been very marked; in 1914 and 1915 over 2,000 and in 1916 over 1,000 licenses were allowed to lapse. Somewhat less than one million acres is private timber land, which is valued at less than $10 per acre, on the average, varying from $3 to $18.31.

The usual fire statistics are elaborated, and show that 1916 was a favorable year when compared with the two years previous. Improvement work in the way of trails, telephones, etc., was cut down to the most necessary limit, less than $8,000 being spent.

B. E. F.

The Effect of the Weight of Acorns upon the Development of Two-year-old Oak Seedlings. G. P. Eytingen, Lesopromishleny Vestnik Nos. 41 and 42. 1915.

Prof. N. S. Nestorov, in the spring of 1914, in the nursery of the Moscow Agricultural College, made an experiment upon the effect of the weight of acorns upon the seedlings. He used in this experiment three grades of acorns: Very small acorns up to 3½ grams in weight, with an average weight of 2.2 grams; medium acorns, ranging from 4½ to 5½ grams, with an average of 4.7 grams, and large acorns, ranging from 6½ grams upward, with an average weight of 6.54 grams. The following spring from 37 to 40 seedlings of each class were examined. The following deductions were made on the basis of this examination: The increase in the weight of the acorns has a considerable effect upon the growth of the young oaks. It affects favorably the total weight of the plant, especially the weight of the root system, and less the longitudinal organs. The height of the stem, however, depends more upon the weight of the acorn than the length of the root. The transition from the smallest acorns to the medium acorns is marked also by an increase in the average characteristics of the oak, and the variability for that group of seedlings is greatly reduced. Further increase in the weight of the acorns affects but little the growth of young seedlings. The small acorns resulted not only in plants which were characterized by poor development, but which also showed a marked variation in its organs. This has been particularly noticeable in the number of leaves; also in the weight of the different seedlings.

Forest Products of Canada, 1916. Pulpwood. Department of the Interior Forestry Branch. Bulletin No. 62B. Pp. 12.

In the eight years since 1908 the pulpwood cut in Canada rose from 482,777 to 1,764,912 cords—almost fourfold and almost double since 1912. The growth was steady and war conditions have practically neither retarded nor increased it beyond the regular increases. This cannot be said as regards value. The cord which in 1908 was valued at $6 had increased in 1916 only to $7.42, or only 22 per cent; but the increase in the last two years is 10 per cent above the previous one.

The Province of Quebec produces about one-half of the total output and Ontario a good third. As regards species, spruce furnished 68.2 per cent and fir 24.5 per cent; but it is questionable whether the spruce output does not contain some fir. As regards processes, sulphite fiber has increased more than any of the other processes, equaling in the last year the mechanical pulp in quantity, which latter, however, increased also by 11 per cent.

Canadian manufacture has increased generally, so that the percentage of export of unmanufactured material has decreased from 40.3 per cent of the total pulpwood cut to 37.7 per cent. This decrease dates since 1912, when export still exceeded home manufacture. But the export of wood-pulp tons since 1908 has shown more than 100 per cent increase, although there were three years of decreases in the steady advancement. In values this increase is even more striking, the values of the last year being more than fourfold those of the first, with $17,344,342, against which a negligible import of $552,000.

A list of active mills, with location maps, is appended.

B. E. F.

A Bud and Twig Key. By O. L. Sponsler. Ann Arbor, Mich. 1916. Pp. 26. Price, 35 cents. George Wahr.

This is a revised edition of a key, published in 1911 in the Nebraska Forest Club Annual, of about 85 species of the more important broadleaf trees of the United States, including a few exotics. For some genera only a genus key is given, partly to save space, partly because no distinctions could be made, as in the case of the ashes and the red and silver maples; the two black walnuts and two of the hickories seem also to present difficulties in distinguishing by bud and twig.

PERIODICAL LITERATURE

SILVICULTURE, PROTECTION, AND EXTENSION

Milestones in Entomological History

Under this suggestive title, V. A. E. Daeke traces the development of entomology from earliest times in an interesting manner.

While insects play a rôle in the early literature of Chinese, Egyptians, Greeks, and Romans, to which references are made, an attempt to describe and classify them is not found before 330 B. C., when Aristotle, most astonishingly successful, grouped the known animals, including insects, and for 1,800 years entomological work was based on this classification, until Linné, in 1758, published the tenth edition of his Systema Naturæ, with the binomial nomenclature fully established, which is the starting point for modern entomology. Then follow the more or less epoch-making works in Europe during the eighteenth century of Geoffrey, Fabricius, Labreille, Cuvier, and an increasing host of others.

In America, out of an amateur society of students of natural history founded in Philadelphia in 1812 the beginnings of entomological study arose. Through the efforts of Thomas Say, the publication of a journal was undertaken in 1817 by the society, then called the Academy of Natural Sciences (Philadelphia), and he became the father of American entomology; but the foundation of economic entomology may be credited to Dr. W. T. Harris, with his report on the insects of Massachusetts injurious to vegetation, in 1841, several editions of which were published. The names of Asa Fitch and C. V. Riley are the most prominent in bringing this phase of entomology to the fore, which has produced about 100,000 works and is being discussed in over 500 periodicals.

The development of forest entomology in particular is dated from 1881, with the publication of Bulletin 7 of the U. S. Entomological Commission on insects injurious to shade and forest trees, which in its revised form (1890) became the well-known volume of A. S. Packard. Dr. Felts' four volumes are also mentioned in this connection and a number of European authorities.

The balance of this excellent article is taken up by a recital of other branches of economic entomology, especially the medical entomology,

lately so much developed, by which so many diseases find their explanation.

Forest Leaves, June, 1917, pp. 43-48.

Smelter-Fume Damage

Within the last decade or two the smelter-fume damage problem has become acute, has given rise to a large amount of litigation and scientific investigation, and has led to the employment of specialized "smoke engineers." One of these, the expert of the American Smelting and Refining Company, Ligon Johnson, brings an interesting account of the historical growth of the problem and of the results of investigative work done in this country. Mr. Johnson is a lawyer, having been in charge of smelter-case litigation in the Attorney General's office, and cannot quite suppress the attitude of an advocate.

A brief reference to European conditions with reference to this problem points out the difference between Germany and Great Britain, the former providing not only for location permits, but strong legislative barriers and supervision by the mine police and mine courts, the latter, although starting consideration of the subject in 1861, having accomplished only partial control legislation.

In the United States only little, and that only local, legislation has been enacted, but a lot of litigation has gone on. In 1872 the first regulation prohibiting the location of smelters within its corporate limits was enacted by Oakland, California, and soon after the California legislature created a commission of inquiry into the effect of fumes. A number of the notable suits are cited, like that against the Shelby, the Tennessee and Ducktown, the Washoe Company, and the Mountain Copper, which latter, as several other cases, was entered by the United States on behalf of the Forest Service.

These suits gave rise to the development of so-called smoke experts, who, according to the author, did not know much, maintaining various theories at variance with each other, upon which the courts gave verdicts, also at variance. Buying off complainants became a general policy of smelter companies until the demands grew exorbitant.

Then the author urged a thorough investigation for the smelters by a competent research department, with P. J. O'Gara, chief expert, and E. P. Fleming, chief chemist.

The findings of the European, mostly German, and previous American investigators are belittled because not secured under normal field conditions; but, so far as we know, the findings of this later commission largely confirm the facts developed by the previous investigators.

The findings may be briefly stated as follows:

Dust and acid vapors are practically negligible quantities, so far as vegetation is concerned; the average vegetation can stand fifty times the strength of acid vapor that it can resist where the sulphur is administered in the form of SO_2.

Only when the plant is in leaf damage from sulphur dioxide results. Treating the soil with sulphur or sulphuric acid results in most cases in increased crop production. This is contrary to A. L. Wieler's, the great German smoke expert, findings!

Damage to the foliage takes place through the stomata, when they are open, which condition is dependent upon the four factors of light, humidity, temperature, and constant wind direction, producing steady influence of the fumes for several hours.

The use of small laboratories in automobiles and a rapid method of air analysis, devised by J. R. Marston and A. E. Wells, permitted the determination of constancy or inconstancy of SO_2 in the fumes at varying distances from the source.

The author then rediscovers the old fact, which makes the smoke expert's work so difficult, that "many diseases, pathological conditions and insect injuries, both externally and under the microscope, present an appearance identical with that of smoke injury." But then he continues with the astounding claim that "in determining the injury of plants by disease we can establish our diagnosis with scientific exactness . . . beyond the possibility of doubt or question," namely, by means of cultures and inoculations, and for insect colonies by collecting the causative insect. The author overlooks that several troubles may occur together, and it would then be necessary to diagnose primary and secondary causes—the very difficulty that troubles the smoke expert.

New is, perhaps, at least in method, the use of guide plants, namely, such as are particularly susceptible to fume injury, like barley, which will show most readily whether fume injury is involved. Priority of invention of the method of using guide plants, in this case the sweet pea, may, however, be claimed by Knight and Crocker in their work on the toxicity of smoke.[1]

A somewhat doubtful claim is made for the benefits which the smelter may confer on agricultural production, or at least from the absence of deleterious effect, a case of potatoes infected by fungi being cited as an example.

---

[1] Toxicity of Smoke. By Lee I. Knight and Wm. Crocker. Bot. Gazette, May, 1913, Vol. LV.

That the visible smelter smoke, contrary to common belief, is "little to be feared as an actual instrument of damage to vegetation" may be open to question, at least it is apt to contain the injurious poison, yet for psychological reasons it might be best to secure clearance.

There is no practical result from the findings discussed except in this one sentence: "Our investigation and the temperature curves (in the stacks) . . . have shown us that where there is fume injury the answer to the problem is in hot gases, gas dilution, and high stacks."

The History and Legal Phases of the Smoke Problem. Bulletin of the American Institute of Mining Engineers, May, 1917, pp. 893-906.

Light and Soil in Natural Regeneration

Coventry discusses the light and soil requirements of different Indian species in natural regeneration and makes some general observations which are worth noting.

On the plains the light conditions on the soil are dependent on the density of the canopy alone, but on hills, for places of the same elevation, the influence of aspect and gradient has also to be taken into consideration; light conditions on a northern aspect under an open canopy may be similar to those under a denser canopy on a southern aspect. For practical purposes the author distinguishes three conditions of light:

(1) Maximum light conditions—*i. e.,* where the soil is entirely unprotected from direct sunlight.

(2) Moderate shade conditions—*i. e.,* where the soil is partially protected either by a light canopy of vegetation, or by the aspect, or by the combined influence of both the vegetation and the aspect.

(3) Heavy shade conditions—*i. e.,* where the soil is more or less completely protected, either by a dense canopy of vegetation, or by the aspect, or by the combined influence of both the vegetation and the aspect.

For the classification of species the author does not use our negative terms—tolerant and intolerant—but the positive terms—"heavy shade demanders, moderate shade demanders, non-shade demanders."

Shade-demanding species require protection from the sun only during their early years, for later on they grow perfectly well with full exposure to the sun, but at the same time are adapted to bear more or less shade. They thus gradually lose their shade-demanding character and become simply "shade-bearers"; but it is important to bear in mind that the term "shade-bearer" implies, in addition to its ordinary meaning, that such species are also shade-demanding for the purposes of their natural regeneration.

From the fact that shade-demanders only require protection from the sun during their early years, and also from the fact that the actinic power of light is almost as great in good diffused light as in direct sunlight, it seems probable that it is protection from the heat effects of the sun rather than from the actinic power of the light which shade-demanders require for their natural regeneration.

In order to obtain a correct idea of the light requirements of different species growing on the hills, for comparison with each other and with species growing on the plains, the influence of aspect must be eliminated by considering under what conditions natural regeneration would take place if the species were growing on a level plain at the elevation of their optimum growth, which in the case of Deodar, would be at about 7,000 feet.

As regards soil, the author points out that the humous content is the important modifying factor, especially as to drainage, aeration, and nitrogen supplies, and recognizes non-humous soil deficient in nitrogen; moderately or well-aerated humous soil, and excessively humous or badly aerated humous soil. The first is found where the soil is exposed to the glare of the sun; the second under moderate shade; the last under heavy shade.

This correlation of soil and light conditions suggests a correlation between light and soil requirements of a species for its natural regeneration. Consequently species adapted to regenerate on a non-humous soil are also adapted to regenerate with full exposure to the sun. Hence, if the light conditions required by a species for its natural regeneration is known, the soil conditions which it requires can be more or less deduced therefrom and *vice versa*. Examples are given to show that this correlation is borne out by observation, and Indian species are classified accordingly and a few practical examples of procedure given.

Correlation Between the Light and Soil Requirements of a Species for its Natural Regeneration. Indian Forester, April, 1917, pp. 186-194.

MENSURATION, FINANCE, AND MANAGEMENT

Standardization of Tree Measurements

In India two methods are used in classifying tree measurements, namely, by girth and by diameter. Girth measurements are made by 18-inch periods (classes), trees over 6-feet girth being called first class. Diameter measurements are made in 6-inch classes, trees over 2 feet in diameter being classed as I, although it is about two-sevenths of a foot greater in girth. Reform in this matter has been discussed in former

issues. Recognizing that 18-inch girth classes are too large, Osmaston proposes as the simplest method to commence with trees 1 foot in girth as Class I and then classifying by 1-foot girth classes *ad infinitum.* The author argues the propriety of bringing this change about presently.

Indian Forester, April, 1917, pp. 183-185.

UTILIZATION, MARKET, AND TECHNOLOGY

Government Sawmills

In reply to a proposal by Adolph Welander in the November, 1916, issue of *Skogsvårdsföreningens Tidskrift,* that the Swedish Government could well establish sawmills, at least in southern Sweden, Otto Hellström argues that such a procedure would be likely to have a dangerous effect upon the economical life of Sweden. He also argues that the results of any such venture should be definitely known before costly experiments are made. Hellström attacks Welander's figures showing the possible revenue to be derived from a typical mill, and asserts that correct figures would indicate that the mill would make a profit of only 1.4 per cent instead of 55 per cent. Fuller investigation of the proposition is demanded.

Skogsvårdsföreningens Tidskrift, March, 1917, pp. 269-274.

Sugar in Waste Sulphite Liquors

The sulphite cellulose made in Sweden is largely obtained from spruce wood. Analyses of this wood by Peter Klason, after deducting the inorganic ash, gave the following results: Cellulose, about 50 per cent; other carbohydrates, about 16 per cent; lignin, about 30 per cent; protein, about 0.7 per cent; resin and fats, about 3.3 per cent.

Klason, in 1893, first established the fact that spruce contained such a large percentage of carbohydrates other than cellulose. Prior to this time only 3 per cent of these were supposed to be found in spruce. Klason called these carbohydrates "lignosans," and supposed that at least a portion of them were combined with the lignin in glucoside-like combinations. With Fagerlund, Klason demonstrated the fact that the greater portion of them, about 10 per cent of the dry weight of the wood, could be extracted from the wood by repeated alternate treatments with boiling water and alcohol. As they constitute about 16 per cent of the weight of the wood, it appears to be possible that a portion of them are in chemical combination with the lignin. (Klason recom-

mends a study of "Die Sulfitablauge und ihre Verarbeitung auf Alkohol," by Erik Hägglund, from which he quotes at length.) E. Öman, in "Teknisk Tidskrift," 1915, suggests that a part of the sugar in waste sulphite liquors is derived from hydrolized cellulose. Klason disagrees with this view.

An analysis of the water-alcohol extract from the wood gave the following results: Xylose, 2.5 per cent; mannose, 0.6 per cent; galactose, trace. The remainder of the extract could not be definitely identified. Klason states that it had a sweet taste and high refractive index. Tests for sugar in waste sulphite liquors by Fehling's solution or Glassman's method give results which are about 5 per cent too high. Similar tests on the lignin-free liquor gave a sugar content of 2.6 per cent, which is evidently too low, as it does not check with the water-alcohol extraction of the dry wood.

Methods for the determination of mannose, galactose, grape sugar, and arabinose are given in some detail. Klason concludes that waste sulphite liquors from the manufacture of spruce pulp contain the following compounds, partly in the form of simple sugars and partly as polysaccharides, calculated on the basis of the dry weight of wood; Grape sugar, 7.9 per cent; mannose, 2.5 per cent; galactose, 1.3 per cent; arabinose, 4.3 per cent. Arabinose is of course not available for the production of alcohol. About 3.8 per cent by weight of the dry wood can be converted into alcohol.

B. L. G.

Om Sockerarterna I Avfallsluten från Tillverkning av Sulfitcellulosa. Skogsvårdsföreningens Tidskrift, March, 1917, pp. 217-228.

River Driving Industry in Sweden

About 72 per cent of the area of Sweden is included in the heavily forested areas of Norrland, Dalarna, and Värmland. This area is traversed in a southeasterly direction by a large number of drivable streams, from the Torne River in the north to the Klar River in the south. Twelve large rivers drain 80 per cent of the 62 million acres included in the area, while a large number of smaller streams are also drivable. The total length of the drivable streams is more than 18,500 miles. From 1908 to 1912, the latest statistics available, an average of 107,697,600 cubic feet of timber was annually floated to the Baltic Sea at an average cost of $0.006 per cubic foot. Seventy per cent of this cost is charged to driving and 30 per cent to sorting.

Sveriges Flottningsväsende. Skogsvårdsföreningens Tidskrift, March, 1917, pp. 276-294.

STATISTICS AND HISTORY

Forestry in Ireland

Mr. H. R. MacMillan brings an interesting, somewhat critical account of forestry conditions in Ireland, which as Trade Commissioner he has personally inspected. Ireland, with only about 300,000 acres of woodland, mostly in small bodies of less than 1,000 acres, has in the Department of Agriculture and Technical Education a Chief Inspector of Forestry, A. C. Forbes, whose business it is to give private owners advice and foster the forestry interests generally. This institution exists since 1899. The department started by acquiring a demonstration area of 500 acres upon which silvicultural methods could be demonstrated, and by establishing a school for the training of foresters, six annually for a three-year course. Over 100 acres of sample plots were planted, at the enormous cost of $34.20 per acre, with 3,000 two-year-olds per acre.

Many exotics, especially Americans, were given a trial, and it appears that the Pacific Coast species are specially adapted to the climate better than Europeans.

In 1908 an annual grant of $28,000 was made to the department for the requisition of woodlands, and by 1914 ten areas, varying in size from 240 to 1,900 acres, had been secured—7,000 acres in all. There are also over 2 million acres of wild mountain land, some of which would be fit for planting, but grazing interests complicate the introduction of such planting policy. The department, however, secured $120,000 from the Development Fund for purchases of such lands, which was done at the exorbitant price of from $9.60 to $14.40 per acre; altogether 7,000 acres in three blocks were acquired and planting on these has begun.

Under the land acts of 1903 and 1909 the government advances money to tenants to enable them to purchase the lands under their occupancy in order to break up large land holdings. Where woodlands were concerned, their destruction was the usual consequence of such purchases until the forest department was given power to require conservation management. There was also provision made for county councils to raise taxes for the acquisition of municipal forests and for free distribution of planting stock. Three counties have taken advantage of the first provision and over one million trees have been distributed.

An annual vote of $48,000 supports the department, consisting now of one chief and two assistant inspectors and a ranger in charge of nurseries.

Mr. MacMillan evidently approves of the educational efforts of this department and properly criticizes the propaganda work in Great Britain as attempting too complicated and ambitious schemes, which have frightened governments, land-owners, and tax-payers, and have earned more opponents than friends for forest planting.

State Forestry in Ireland. Canadian Forestry Journal, June, 1917, pp. 1168-1172.

Conifer Supplies in India

E. A. Smythies analyzes the requirements of India in the way of coniferous wood, which could be supplied by development in the Himalayas. In spite of over one million acres of coniferous forest, such supplies have hitherto been imported from foreign countries to the extent of over 30,000 tons in 1913-14, mostly from the United States. The enormous drop in imports for the first war year to less than 6,000 tons has created a real timber famine, which threatens to increase and arrest the industrial development that had only lately begun.

Discussing the various uses of coniferous material in India, the author comes to the conclusion that pine timber is most needed, with spruce and fir secondarily.

Inaccessibility and lack of means of land transportation have prevented the development of Himalayan woods for the rosin industry. Experiments are being made to float resin produce in tin cans.

To develop the conifer forests there are needed capital, trained men for administration, and experts to find new uses.

Forest planting of bare hillsides is also advocated and conversion of the valueless oak forest—first, experimentally, and, when the development of the native conifer forests furnishes the needed income, working on an enlarged scale.

Possibilities of Development in the Himalayan Coniferous Forests. Indian Forester, April, 1917, pp. 165-172.

MISCELLANEOUS

Commercializing Indian Forestry

R. S. Pearson, of the Indian Forest Service, after illustrating the technical and commercial sides of Indian Forestry, advocates the employment of business men to handle the commercial side of the forest business, leaving the purely technical work to the forest school-trained men. He feels that it would

be impossible to curtail the technical training in Europe in order to give more training in business. Therefore he advocates:

". . . The most satisfactory solution would be to employ a certain number of business men to carry out the commercial work of the forest department. . . . I would . . . advocate the appointment of permanent men not only to look after sales of timber and minor products, but to endeavor to find new markets for those forest products not at present exploited, to improve existing forest industries, and, where possible, start new industries."

T. S. W., Jr.

The Indian Forester, March, 1916, pp. 103-107.

War-time Use of Forests in Germany

Through the Schweizerische Zeitschrift für Forstwesen we learn of the publication of a small pamphlet containing three addresses before the Forstwirtschaftsrath in Berlin, 1916, by three well-known authors — Riebel, Wappes, and v. Mammen, referring to the influences of the war on the condition of forest use and management.

In the line of utilization forest by-products have assumed a more prominent rôle, so that here and there their development almost exceeds in importance the wood utilization.

Pulpwood is increasingly used in new directions; roots are dug to increase fuel supply; much small material, brush, finds a market and permits silvicultural measures which formerly had to be omitted. Berries, mushrooms, and other forest fruits have become important and are being increased; many weeds, like nettle and thistle, can be used for pig feeding; heather is ground into fodder meal; foliage and brushwood is dried and ground and used as fodder. Nettles are cultivated for their fiber. For tanning materials not only oak and spruce bark, but oak and spruce brush, is used; the resin industry is revived; ethyl and methyl alcohol are made from wood waste.

Even before the war wood prices had been soaring, so that the condition of the wood market could be used as barometer of general economic conditions, and they have risen during the war still further. Unfortunately no definite figures are given.

Wald- und Forstwirtschaft im Kriege. Schweizerische Zeitschrift für Forstwesen, May-June, pp. 184-185.

NOTES AND COMMENTS

Owing to his having been called to active duty with the Engineer Officers' Reserve Corps, Mr. R. Y. Stuart has found it necessary to submit his resignation as Secretary and Chairman of the Meetings Committee of the Society of American Foresters. His resignation has been accepted by President Filibert Roth, who has appointed as his successor for the remainder of the calendar year Mr. E. R. Hodson, Forest Service, Washington, D. C.

Notice has been received by the Society of American Foresters from the Secretary of the American Association for the Advancement of Science, that the annual meeting of the Association will be held at Pittsburgh, Pa., December 28, 1917, to January 2, 1918. Members desiring to submit papers are requested to send them to the Secretary of the Society of American Foresters, Atlantic Building, Washington, D. C., in order to arrange for their presentation. It does not seem practicable for our Society to meet in conjunction with the Association in its annual meeting at Pittsburgh this year.

Labor Unrest in the Lumber Industry

The lumber industry, especially in the "Inland Empire," has recently had a great deal of labor trouble, chiefly with the "I. W. W." Conditions have become so strained that in some sections in Washington it has been necessary to call out State troops to keep order. Strikes have been started at various mill plants and most of the logging camps in the Cœur d'Alene country in Idaho are shut down.

Mill-workers are making demands for a minimum wage of $3, Sunday and overtime work to be paid at the rate of one and one-half, abolition of tokens and trading coupons, heated lunch-rooms on the premises equipped with tables and chairs, sanitary toilets in all mills, all sorting tables to be roofed, no loss of time when breakdown occurs and men are kept on the job, no discrimination against any member of a labor organization, employers to collect union fees, all fluctuations in wages or cost of board to be subject to 30 days' notice, and certain specified days to be considered as holidays. Loggers demand an 8-hour

day, \$3.50 minimum wage, with other stipulations to conform to the demands made by the millmen.

Labor disturbances in the lumber industry of the Northwest are symptoms of a social disease. They are natural and expected results of a sawdust-pile, transient, mill-shack-town form of economic development, which has been notoriously characteristic of the development of the lumber industry in the United States. To attempt to kick or kiss away the trouble without an open-minded, sympathetic, scientific inquiry into the fundamental causes is both dangerous and futile.

Many of the demands of the workers in the woods are not only just, but are essential if ordinary decent standards of sanitation, recreation, and the like are to be assured. The dirty, ill ventilated, uncomfortable, and unattractive logging camp has been the rule rather than the exception. "River pig" and "lumber jack" have been terms of contempt. The atmosphere of distrust and suspicion, accentuated by the black list, the lack of social imagination by the employers in the handling of the big human problem, and the wretched living conditions of the "lumber jacks" has provided a most fertile field for the agitator. The agitator in his endeavor to correct conditions no doubt goes to extremes at times. This, however, is not the important question involved. There is too much concern for the particular criminal in such cases and not enough for the causes of the crime. A sincere attempt must be made by the industry to determine fundamental causes for this agitation, and with courage, sympathy, and imagination it must work out some basis of adjustment. Palliatives in the form of the cleaning up of camps, the providing of some recreational facilities, and the like, will, when put into effect in the right spirit by the industry, form the basis for a truce and be a start in the right direction. Such work will not be effective if done in the spirit of patronage or largess. The industry should recognize, however, that any settlement on this basis will only be a temporary truce, for the whole question goes deeper. The stability and permanency of the lumber cut by regions must be assured in the industry if the human side of this problem is eventually to be solved with a reasonable degree of satisfaction and social justice. It is imperative to the success of the industry that the confidence between workers and employers be restored. There is but one way in which this stability, permanency, and confidence can be brought about, and that is through conservative forest management, including fire protection, continuity and regulation of cut, which would make possible the building up of permanent communities of forest workers. Permanent homes and the enjoyment of the privileges and social advantages

of free citizens will do away with the unrest and bring harmony into the industry. Unless the private timber owners realize their obligations and responsibilities in the permanent development of the forest resources, public ownership must ultimately become the only solution of this labor unrest.

Private Forestry

Some years back the territory of the Chateaugay Ore and Iron Company, in the Adirondacks, was pointed out as one of the worst examples of what forest destruction and creation of waste by ax and fire could do to mar the scenery. It is gratifying to note that for a number of years the Delaware and Hudson Company and its subsidiary companies—the Chateaugay Ore and Iron Company and the Northern New York Development Company—under present management have tried to make amends by supporting a Woodlands Department, which is charged not only with exploitation, but with the systematic handling of the woods interests, including reforesting operations on a comparatively large scale.

Lately the Society of Northeastern Foresters held their annual summer meeting at Bluff Point, partly as guests of the company, as reported in another place of this issue. In this connection we were privileged to inspect a progress report of the company's Superintendent of Woodlands, Mr. H. R. Bristol, from which we extract the following facts:

It appears that the property mainly involved, located in Franklin and Clinton counties, New York, covers approximately 110,000 acres, of which 80,000 acres are still revenue-producing. In the past, revenue has been mainly derived from the sale of pulpwood, under the articles of a long-term contract, and which in the last four years has yielded an average annual gross revenue of $140,000. The contract terminates this year, and the immediate future income will be confined to small sales of hardwood and possibly aspen. Cutting regulations have not been possible under the terms of the contract above mentioned except in the matter of closer utilization.

Small beginnings, however, in reforestation were made more than a decade ago, but little was accomplished until 1915, and the report in this respect refers mainly to the last three years.

The expenses of the Department average about $120,000 per year, of which around 10 per cent is for supervision. Some $20,000 in all were spent for line and timber surveys; for topography the United

States Geological Surveys are considered sufficiently accurate. These topographical maps, however, on a scale of 1 inch to the mile, are not considered sufficient for the plotting of detail frequently called for, in which case the scale employed is usually 4 inches to the mile.

While small plantations have been established in other locations, 4,350 acres of the Adirondack property have been reforested to date. This is a trifle less than 4 per cent of the property. A 6 by 6 spacing has been used. Altogether some $50,000 were spent on these plantations since 1908, which would make the average cost $11 per acre. The exact cost per thousand of the different sizes and species is not apparent from this report. A detailed statement of planting costs, exclusive of cost of plants and supervision, however, on the basis of 3,800,000 trees, shows somewhat below $5 per thousand for the last four or five years.

The nursery labor account shows an average of 72 cents per thousand against seedlings ready for transplanting and $2.70 against transplants, or a total charge of $3.42 for labor alone on stock ready for the field. In the nursery account no charge appears for seed, materials, or supervision; otherwise the detailed figures average as follows for the last three years:

	Seedlings	Transplants
Making beds....................	$0.37 per bed	$0.70 per bed
Seeding and transplanting......	.18 per M	.59 per M
Weeding	.10 " "	.52 " "
Protection	.02 " "	.20 " "
Digging and packing...........	.07 " "	1.20 " "

The fall inventory of the Bluff Point Nursery for 1916 reports altogether some three million seedlings, one and two years old, and a million and a half transplants, while two other nurseries—one at Wolf Pond and the other at Oneonta—are not reported in detail, these nurseries having been abandoned.

In the nursery we note red pine is being given the largest share, and next comes white pine, while in the plantations to date Scotch pine has been given apparently the largest share with a variety of other species, hardwoods and conifers being represented among them, poplar to quite an extent, and spruce.

No need to say that protection against fire was a point of first consideration, and State co-operation has largely solved the problem, the State maintaining three fire lookouts. The company maintains four subsidiary lookouts in conjunction with its patrolmen. As the plantations increase the need of protection increases.

The company has adopted a policy of reforesting at least a thousand acres per annum.

While this enterprise is not a very large one, it is commendable and hopeful in its results.

B. E. F.

At a meeting of the National Lumber Manufacturers' Association, held June 20, 1917, a new form of organization was effected which is designed to bring about a greater degree of co-operation among the regional lumber associations which comprise its membership. In the future the secretary's office will issue to trade journals a monthly report of the activities of the National Association, in the belief that these activities are of general interest to all branches of the industry. Statistical information collected by the association will be distributed through the affiliated secretaries as heretofore. A regular monthly bulletin will also be issued. An assessment of three-fourths of one cent per 1,000 feet instead of a voluntary subscription, as has been the custom heretofore, will provide about $100,000 annually for association work. The field of work now outlined includes trade extension, legislation, national market information, and association co-operation. Some interesting facts in regard to trade extension have been brought out in this connection, namely, that in the consumption of 80 per cent of southern pine and Douglas fir the buyer has no thought or intention of using other than southern pine or Douglas fir, but the remaining 20 per cent is sold under competitive conditions in the territory between Iowa and New York, and while 15 per cent of this trade is probably converted to the use of some wood, the remaining 5 per cent must be persuaded to use wood instead of some other construction material. It is this 5 per cent that national trade extension attempts to secure. This necessitates both defending wood as a construction material and also increasing its use. In this field the National Association is concerned in the development of the markets of wood as a whole, leaving to sectional associations the advertising of a given species.

The National Hardwood Lumber Association, on June 15, 1917, adopted a revised set of rules for grading cypress lumber, which are to a large extent in conformity with the standard rules of the Southern Cypress Manufacturers' Association. The former cypress rules of the association had become antiquated and did not meet the needs of the trade.

An article in the *Canadian Forestry Journal,* by A. W. Schorger, chemist in the U. S. Forest Products Laboratory, describes the uses of wood and wood products for the belligerent forces and uncommon ways in which they are of use to the civilian population.

Charcoal, for this purpose best made from dogwood, willow, and alder, forms 15 per cent of ordinary black powder, which is useful in shrapnel shells, the smoke produced helping the gunners more correctly to determine the range, and it alone has been found satisfactory for filling the rings of time fuses of these shells. Resin is employed for filling the spaces between the bullets, its low melting point making it acceptable for this purpose. Black powder is also used for armor-piercing shells, high explosives not being satisfactory, since they explode on contact. The Allied forces are still wondering where Germany secures nitrocellulose for the manufacture of smokeless powder, since cotton was made contraband of war, and the general belief is that wood is the raw material from which it is obtained.

Resin is used in civilian life in the making of cheap soaps and size for paper. A recently proposed substitute for this latter use has as its base again a forest product, namely, wood tar.

One rifle per man per month is the estimate given by the supply department, which means an enormous drain on American walnut trees, the best wood for the purpose of gunstocks, birch sometimes being used as a substitute. Rapid destruction of bridges, etc., by a retreating army necessitates their hasty replacement by the pursuers, and wood is usually the most easily available material. Trench warfare, of course, makes great inroads upon forests for walls, floors, braces, etc. The work of the construction and engineering battalions calls for material for railroads, etc. Germany is using absorbent surgical dressings made from wood cellulose, Sweden having two factories engaged in this manufacture, slings from crepe paper, and splints from fiber boards. Russian soldiers are wearing paper shirts, recent weather-proofing processes having greatly improved these garments, which have been used in Japan for many years; the fact that they are cheap enough to be discarded when soiled being, of course, favorable to their use by men in active military life.

As regards the civilian population, first, non-combatants made homeless have again to be provided with temporary shelter, and again wood is the most easily available material. The poorer classes among the Germans and Austrians use paper vests, socks, and handkerchiefs; blankets and coats are padded with cellulose wadding; mattresses are filled with tree foliage and sphagnum moss.

Methyl alcohol and acetic acid, distillation products of hardwoods, are useful in both civilian and military life for medical preparations and for aniline dyes, and formaldehyde, another forest by-product, is a most efficient antiseptic.

The newsprint paper situation has been receiving considerable attention on this continent of late, and in this connection it is interesting to note that, although there has been a reduction in the number of daily papers and periodicals published in some of the warring countries of Europe, due to the prohibitive price of paper, the daily circulation of papers giving news has increased and large numbers of books and pamphlets on war subjects are continually being issued.

In conclusion, the author states that the U. S. Forest Products Laboratory has shown by experiment that some seven or eight American woods, besides spruce and balsam fir, are satisfactory for the making of newsprint paper, and that cordage, ropes, burlap, and similar articles can be made from wood fiber; and hence the United States, in case of war with Mexico, should be in a position to supply the great quantities of twine and hemp needed in the harvesting of the grain crop, the binder twine used in recent years having been made from sisal, imported from Central America and Mexico.

The summer field meeting of the Association of Eastern Foresters was held July 11 to 13 at Bluff Point, New York, the members being guests of the forestry department of the Delaware and Hudson Railroad. About 30 members and guests were present.

The party assembled on Wednesday afternoon and evening at the Bluff House. The first afternoon was devoted by some to an inspection of the D. & H. nursery and to a visit to the Plattsburg military training camp.

The main field trip was on Thursday and included an inspection of a portion of the 6,000 acres of plantations near Wolf Pond. The early plantings in 1909 were largely confined to Scotch pine and white pine, but future efforts will be devoted chiefly to reforesting with red pine, owing to the possible damage to white pine from blister rust. While Scotch pine has made an excellent growth it is believed that greater returns can be secured from the use of red pine, owing to greater yield per acre and to the higher quality of material produced.

An excellent buffet luncheon was served at a hunting camp on the Wolf Pond tract by the dining-car department of the railroad, after which the party went by train to Dannemora, where a trip was taken

through Clinton prison. Following this the party motored to Plattsburg and again inspected the training camp.

Thursday evening was devoted to an informal discussion, led by A. F. Hawes, of the possible fuel crisis in the Northeast and the steps that can be taken to ameliorate the situation. It was the consensus of opinion that great stress should be laid on a heavy cordwood cut by woodlot owners during the fall and early winter. It was pointed out that not only would this decrease the pressing demand for coal, but would also enable woodlot owners to improve their woodlots and market inferior material at a profitable price.

The propaganda work along the above lines is being carried on by the various State Foresters and by the forestry departments in New England collegiate institutions.

An effort will be made to secure the co-operation of municipalities in finding a market for fuel and in lending encouragement to the cutting of wood by timber owners in the vicinity of such towns.

Friday morning was devoted to an inspection of the railroad nursery at Bluff Point, which has an annual capacity of more than one million transplants.

Great credit is due H. R. Bristol, forester for the railroad, for the well arranged and very instructive field trips and for the excellent accommodations furnished.

Thirty members of the Massachusetts Forestry Association, under the leadership of Dr. Clinton L. Babcock and H. A. Reynolds, of Boston, visited the Chelan, Rainier, Oregon, and Crater National Forests the latter part of July, on what is known as the National Parks and Forests Tour. Local forest officers co-operated with them to make their visit pleasant and instructive. Supervisor MacDaniels accompanied them on the Chelan, Forest Examiner Fenby on the Rainier, Supervisor Sherrard on the Oregon, and National Forest Examiner Matz on the Crater.

The party spent three days in Portland and vicinity. The first day they visited a mill where logs five feet in diameter were reduced to lumber. Several 80-foot logs were also cut up for ship timber during their stay. They also visited a shipyard and saw a wooden steamship under construction. In the evening they listened to a talk, illustrated by 125 lantern slides, on the work of the Forest Service by Mr. Jackson.

The second day was devoted to an automobile trip over the Columbia River Highway and a picnic lunch at Eagle Creek camp grounds.

Mr. Sherrard addressed the party informally after lunch. S. C. Lancaster told about the building of the Columbia River Highway. Four of the younger members of the party, headed by Mr. Reynolds, Secretary of the Association, made the trip up Eagle Creek trail 2½ miles to the Punch Bowl. On the way back to the camp grounds one member of the party said it was the finest trail they had seen on their trip.

The third day was spent in sight-seeing about Portland, and the party left for Crater Lake and southern points in the evening.

The Massachusetts Forestry Association has a membership of 3,000. Secretary Reynolds states that it is planned to arrange a western trip annually, so the members and their friends can see the National Forests and Parks and become better informed regarding their administration and use. At the same time, the trip will make a wonderful outing for all who take it.

The *Chicago Daily News* is authority for the statement that large sums of money have been subscribed in Germany for the exploitation and manufacture of a new material which it is expected will make Germany independent of the importation of cotton, jute, and wool. The material is made from "typha," a species of cat-tail growing in marshes, and can be worked into threads according to the kind of cloth to be made. There are many varieties of the plant, having different fibers, which can be worked into coarse or fine materials, having both strength and softness of texture. The lowest estimate of the crop of typha for last year was 500,000 tons; the yield in finished product is 10 per cent. Good land is not needed for this crop. Germany has extensive marshes, which it is proposed to sow with the plant. The cost of growing, harvesting, and manufacturing into the different materials required is estimated to be much less than the normal cost of such goods imported. The industry is being developed to fulfill the present war needs and for commercial purposes after the war.

D. T. Mason, formerly Professor of Forestry in the University of California and now Captain in the 10th Reserve Engineer (Forest). Regiment, has an article in the *American Lumberman,* June 30, 1917, on "How the Lumber Industry Can Help in the War." He urges, among other things, greater economy in the use of food supplies in camp, the production of food crops in gardens by loggers and mill workers, production of forage crops for logging animals, introduction of labor-saving machines, and a general increase in efficiency along all lines.

The U. S. Secretary of Agriculture has amended the white-pine blister rust quarantine promulgated April 21, 1917. This amendment is made effective May 1, and prohibits the movement of white pines and black-currant plants from the New England States to points outside of New England. This action was necessitated by the considerable movement now under way of possibly infected white pines, and to a less extent black currants, from New England to States lying west and south. Both of these plants are important carriers of the blister-rust disease, and most of the States to which these shipments were being made have State quarantines prohibiting the entry of such stock.

Because of a possibility of a coal shortage in the West next winter, by reason of the increased demand for coal by industrial plants and the lack of sufficient means of transportation, the Government is urging, through its foresters, more extensive use of fuelwood by ranchers and town dwellers. The supervisors of the 153 National Forests will be instructed to afford all possible facilities to local residents wishing to obtain cordwood. The material thus utilized being mainly dead timber, insect-infested, or old and deteriorating, its use by settlers will help clear the forest; but where fuelwood of this character is not obtainable the cutting of mature living trees will be permitted to the extent necessary to meet the demands.

During the last fiscal year over 30,000 permits for the free use of National Forest timber, mainly in the form of fuelwood, were taken out by local residents. The amount of timber involved approximated 250,000 cords, additional supplies of cordwood being obtained at a nominal price by others not entitled under the law to the free use of timber.

The U. S. Forest Products Laboratory, according to a news item in a recent issue of the *American Lumberman,* has been investigating the suitability of several species of wood as separators in electric batteries. The essential requirements are that the wood have mechanical strength and porosity to sulphuric acid, and that it must not liberate organic acids, which would attack lead. Basswood, longleaf pine, cherry, maple, and cypress have been tried without great success. The most satisfactory woods are Douglas fir, redwood, and Port Orford cedar. It is believed that Alaska cedar would also prove satisfactory.

In order to facilitate the purchase of war material and supplies, the Federal Trade Commission has been directed to determine the actual

present cost of producing ship timber to be used in the construction of the emergency fleet. The present investigation is not concerned with the price of lumber itself, but rather costs of production. J. M. Gries, of the School of Business Administration in Harvard University, has been placed in charge, under the general supervision of the advisory economic board of this commission. Mr. Gries, an accountant by profession, is well fitted for this task, having been associated with the Bureau of Cooperation in their study of the lumber industry made some years ago.

Announcement of the arrival of Henry S. Graves, Chief of the U. S. Forest Service, in Paris, has led the Department of Agriculture to explain that Mr. Graves has gone abroad to make arrangements for the forest work which the American army engineers will undertake in France in connection with the military operations of the allied forces.

Because of the opportunity for service by this country in woods work incidental to the war, which the request of the British Government for the sending of a forest regiment was believed to present, Mr. Graves has been granted leave of absence from his position as head of the Forest Service and has received a commission as Major in the Reserve Engineer Corps. He has not been assigned to any command, but is acting under instructions, it is stated, to proceed to France in order to learn on the ground in advance just what conditions will need to be met, what equipment will be called for, and how extensively the services of American lumbermen can be utilized to advantage.

One of the staff officers of the regiment, Captain Barrington Moore, is with Mr. Graves for the purpose of arranging for its prompt assumption of the specific duties to which it will be assigned when it is landed in France. While organized on military lines, the work of the regiment will be industrial, not combatant. It will operate in the woods behind the armies, getting out timbers, trees, and lumber required for military purposes.

A ranger station in the Coconino National Forest has been named the Fernow Station in recognition of the services rendered to the forestry cause by Mr. Fernow. It replaces the less euphonious name of Potato Patch Station.

The U. S. Forest Products Laboratory at Madison, Wis., has recently given out a statement in regard to the production of ethyl alcohol from sawdust, which is timely, in view of the possible prohibition of

the use of grain or molasses for this purpose. One ton of dry coniferous sawdust or other form of waste will yield from 15 to 25 gallons of 190-proof spirit.

In brief, the process of producing ethyl alcohol from wood consists in digesting in rotary digesters the sawdust or logged and shredded waste with dilute sulphuric acid at a steam pressure of 60 pounds or more for a short period. The digested material is next transferred to a diffusion battery similar to that used in the extraction of sugar from sugar beets or dyes from dyewoods, and here the sugar and other water soluble material is extracted with hot water from the digested sawdust. The acidity of the extract is then neutralized with lime, and the sludge formed by the calcium sulphate and some of the dust carried in the extract is allowed to settle out, a process requiring from 15 to 24 hours. The clear solutions are then drained off and cooled to the proper temperature for fermentation. The fermentation, distillation, and rectification of the alcohol are accomplished in the usual manner.

The essential parts of a plant necessary for the production of ethyl alcohol from wood are as follows: Adequate sawdust storage, disintegrating equipment—hogs, screens, shredders, sawdust storage above digesters, acid storage, digesters, diffusion battery, neutralizing and settling tanks, coolers, fermenters and yeast equipment beer still, rectifying still, bonded warehouse, boilers and engines, laboratory and office.

A properly constructed plant, convenient to an adequate supply of waste wood and with plenty of good water and sulphuric acid easily accessible, and designed to produce from 2,500 to 3,000 gallons a day, can make ethyl alcohol at a cost of from 14 to 20 cents per gallon, including all overhead expenses.—*American Lumberman,* August 4, 1917.

The Forest Service issues free certain lists in mimeograph form which are of value to those interested in forestry. These are:

1. "Private foresters and consulting timber and logging experts." A list of 22 men or firms who advertise to give advice on forest lands.

2. Dealers in forest planting material of various kinds of trees. About 40 lists have been prepared giving the names and addresses of nursery men and seed collectors who sell seed, seedlings, or transplants, including cuttings for the production of basket willows. (Those who sell ornamental trees and shrubs only are not put on these lists.) Applicants should give the names of trees in which they are interested.

3. "Willow-ware manufacturers." This list is intended for basket-willow growers who wish to obtain the names of possible purchasers of willow rods.

The Forest Service will welcome at any time corrections or additions to these lists. It should be borne in mind, however, that such changes will usually be made only when a new edition of a list is issued.

The Atlantic Paper and Pulp Corporation is now building a pulp mill at Port Wentworth, Ga., which will manufacture daily 50 tons of sulphate pulp. The raw material will be secured from small timber, waste slabs, and trimmings from the Port Wentworth Lumber Company's logging operations and sawmill plant.

The District 1 supervisors' meeting was held January 29 to February 5. It was a very interesting meeting and many questions of policy were discussed. The supervisors felt that they are an important feature of Service work and voted to hold them every two years.

The supervisors recommended that action be taken so that men on the forest assistant register could be appointed to the position of forest ranger, and also so that questions in the forest ranger examination should cover points of silviculture and grazing, leaving certain portions of each optional.

Mr. Humiston, of the Potlatch Timber Protective Association, gave a short talk on the relation of relative humidity to the fire season. He is of the opinion that the danger is greatest when the relative humidity is low. He stated that in parts of northern Idaho during the most severe portion of the fire season that the relative humidity was lower than that of the average for the Sahara Desert.

The ranger conference held at the Saranac Nursery from February 5 to April 1 was enthusiastically indorsed by the men assigned. The discussions at the conference were confined largely to the problems of the field man, with special emphasis on questions of administration, surveying, silviculture, and improvements. The chief criticism of the men was that the time allotted for the conference was not sufficient to cover the subjects thoroughly. The supervisors that have had men detailed to the conference in the past believe it stimulates the men to better efforts and lays the foundation for further study along special lines.

The extensive and intensive land classification work is now practically finished in District 1, and the next big undertaking before the

office of lands is securing data for the acquisition of privately owned lands within or adjacent to the boundaries of the Forest. This work will be started within the next few months.

The Sioux National Forest, in southeastern Montana and northwestern South Dakota, was covered during the spring and early summer by a timber survey, having for its purpose the collection of data upon which to base a detailed intensive working plan. The demand for timber on the Sioux probably exceeds the supply, and the necessity of placing the cut of the Forest on a basis of sustained yield has been felt for some time. The local demand for fence posts and poles, house logs, fuel, and sawtimber is so insistent that practically every kind of conservative cutting known to forestry can be used to advantage in the different stands. The timber survey crew worked under the direction of F. J. Klobucher, and the compilation of the data and the preparation of the plan is being handled by W. L. Baldwin.

The fire situation became seriously acute in District 1 during the last two weeks in July, when large fires were reported from Cœur d'Alene, Pend Oreille, Cabinet, Kootenai, and Flathead Forests. Supplies and men for the overhead organization were rushed from the district office to strategic points, and all lines of activity have been temporarily subordinated to the needs of the fire organization. Employment and supply headquarters have been established in Spokane, Great Falls, Butte, and Kalispell, and preparations have been made to fill requisitions for men and equipment on short notice. Over the larger part of the district the precipitation during June, July, and August was negligible, and the situation is serious.

The lumber interests of New England have organized a sawmill contingent of ten companies, which recently sailed for Great Britain to aid in getting out timber for the Allied armies. The contingent, numbering 355 picked men, was recruited and equipped by the lumbermen at an expense of $140,000. The English Government furnished transportation and will pay the wages of the men. D. P. Brown, of La Tuque, Quebec, of the Berlin Mills Company, is manager and E. H. Hirst, State Forester of New Hampshire, is assistant manager of the contingent. Each of the ten companies is in charge of a practical portable sawmill man from New England. Before sailing the men signed up with the British consul for one year's service, one of the conditions of

the contract being that the contingent shall not be called upon for service outside of England, Scotland, and Wales. Each mill unit has its own complete organization, the management maintaining a general oversight of the whole.

The State of Massachusetts experienced a notable loss in the death last November of the chairman of the State Forest Commission, Harold Parker, who was largely instrumental in securing the three State Forests, one of which is named after him. At a meeting of the Forest Owners' Club, of which he was a member, a highly flattering memorial regarding the services of Mr. Parker was passed.

S. N. Spring and H. E. Schmelter, of Cornell University, report the following instances of the death of trees surrounding ant hills (see Journal of Forestry, Vol. XV, p. 108): White pines and red pines set in plantation on university land in 1912. Damage observed in dense natural growth of young white pines; trees killed included large-toothed poplars; south of Ithaca, near Wilseyville, Tompkins County, New York.

The Minnesota legislature has passed a law giving the State entomologist needed authority to combat the white-pine blister rust in that State, and has appropriated for his use $15,000 for the biennium for fighting this disease. The United States Government will also use in the State an equal sum.

In Minnesota a "public domain bill" was before the legislature, providing for a forester under the "commissioner of lands, forests, and immigration," who is again subordinate to the "director of public domain," appointed by the Governor. Various other items of divided authority also are incorporated. A thoroughly bad bill!

The previous legislature had cut down appropriations for the State Forest Service from $75,000 to $40,000, crippling especially the fire-control work.

The Forestry Board had several bills before the legislature, besides asking for restitution of the larger appropriation. Among these were one bill asking for a special appropriation for planting State lands; a bill asking for an emergency fire-fighting fund, available for contingencies; a bill providing for an inventory of all timber on State lands;

a bill providing for the establishment of State forests under the authority of a constitutional amendment passed two years ago for making forest reserves of lands found by the soil survey fit only for timber-growing, such lands having now been designated.

The legislature of the State of Washington enacted at its last session a law providing for an exchange of State lands with the Forest Service. An appropriation of $7,500 for examination was carried in the bill, which was signed by the Governor.

Chief Forester Graves had previously approved the selection of lands by the State in the Sultan River basin, Snoqualmie Forest, which the State will acquire by exchange, giving in lieu title to sections 16 and 36 in all the forests in Washington. It is the purpose of the State to later exchange this land for lands held by the University of Washington. It is stated that the conditions are ideal for a demonstration forest and experiment station. The College of Forestry will establish summer terms and practice sustained-yield methods.

The Pennsylvania Forestry Association, under the auspices of the Chamber of Commerce of Pittsburgh, arranged a summer forestry conference on June 21-23, participated in by several other conservation agencies. Owing to the Red Cross campaign being on at the same time, the participation by local interests was but slim.

A literary program was participated in by Mr. Wirt, Chief Fire Warden; Mr. Hall, representing the U. S. Forest Service; Mr. Phillips, State Game Commissioner; Prof. Sanders, Zoologist; Dr. Rothrock, Professors Roth and Fernow; Dr. Drinker, President of the Association, presiding. Automobile trips through the city and surroundings and an excursion by special train to Killarney Park were generously tendered by the Chamber of Commerce. A full report and some of the addresses will be found in Forest Leaves.

The Intercollegiate Association of Forestry Clubs, a student organization, held its third annual meeting at Seattle, under the auspices of the Club of the University of Washington, in March, ten clubs being represented. A news letter of 12 mimeographed pages legal cap, issued by the president of the club, gives full account of the meeting, which lasted three days, and brings reports from the various clubs describing their various activities. We congratulate the clubs, and especially the president club, on the success of their enterprise, which cannot fail to

create a spirit of good fellowship among the students of the professional forestry schools. This object we believe can be accomplished by such meetings and reporting them, as in the present case, without a special regular publication, which is under discussion. The publication of a song book, however, as proposed would be a good move. A motion was carried to inform the Society of American Foresters that the Association of Forest Clubs were desirous of becoming junior members of the Society. The Yale Club was elected the next president club.

To the many magazines dealing with forestry to stimulate local interest another monthly has been added by the University of California Forestry Club, under the title *"California Forestry,"* at a subscription price of one dollar—Ansel F. Hall, manager—the Sierra Club members being specially invited to become subscribers.

Prof. Francis G. Miller, lately of the State College of Washington, has been called to the deanship of the School of Forestry in the University of Idaho, at Moscow. The forestry work at this institution had so far been in the College of Letters and Sciences, but now becomes an independent organization and is promised further development.

The summer field meeting of the Association of Eastern Foresters was held July 11 to 13, at Bluff Point, N. Y., the members being guests of the Forestry Department of the Delaware and Hudson Railroad. About 30 members and guests were present.

The party assembled on Wednesday afternoon and evening at the Bluff House. The first afternoon was devoted by some to an inspection of the D. & H. nursery and to a visit to the Plattsburg military training camp.

The main field trip was on Thursday and included an inspection of a portion of the 6,000 acres of plantations near Wolf Pond. The early plantings in 1909 were largely confined to Scotch pine and white pine, but future efforts will be devoted chiefly to reforesting with red pine, owing to the possible damage to white pine from blister rust. While Scotch pine has made an excellent growth, it is believed that greater returns can be secured from the use of red pine, owing to greater yield per acre and to higher quality of material produced.

An excellent buffet luncheon was served at a hunting camp on the Wolf Pond tract by the dining-car department of the railroad, after which the party went by train to Dannemora, where a trip was taken

through Clinton Prison. Following this the party motored to Plattsburg and again inspected the training camp.

Thursday evening was devoted to an informal discussion, led by A. F. Hawes, of the possible fuel crisis in the Northeast and the steps that can be taken to ameliorate the situation. It was the consensus of opinion that great stress should be laid on a heavy cordwood cut by woodlot owners during the coming fall and early winter. It was pointed out that not only would this decrease the pressing demand for coal, but would also enable woodlot owners to improve their woodlots and market inferior material at a profitable price.

The propaganda work along the above lines is being carried on by the various State Foresters and by the forestry departments in New England collegiate institutions.

An effort will be made to secure the co-operation of municipalities in finding a market for fuel and in lending encouragement to the cutting of wood by timber owners in the vicinity of such towns.

Friday morning was devoted to an inspection of the railroad's nursery at Bluff Point, which has an annual capacity of more than one million transplants.

Great credit is due H. R. Bristol, forester for the railroad, for the well arranged and very instructive field trips and for the excellent accommodations furnished.

Pulpwood Supplies in Quebec

In a report to the Royal Dominions Commission, Mr. Ellwood Wilson, Forester of the Laurentide Paper Company, develops some statistics and facts of interest regarding pulpwood supplies in Quebec.

The total timber area of Quebec north of the St. Lawrence, the principal pulpwood area, is given as 303,855 square miles. Of this, however, only 147,247 square miles, or less than 50 per cent, are accessible by water and rail; the balance "will not be accessible until railroads are built into the far north."

The whole area can be divided into six watersheds as follows:

	Square miles
James Bay watershed	73,745
Ottawa watershed	37,166
St. Lawrence watershed	104,806
St. Maurice watershed	15,925
Saguenay watershed	35,157
Height of Land, east of L. St. John watershed, to boundary	37,056

Mr. Wilson also distributes the area to the various forest types as differentiated by Fernow (see *Forestry Quarterly,* Vol. VI, page 341, and *Proceedings Society of American Foresters,* Vol. VII, page 133), giving area, the percentage of timbered area, available and not available, and cords per acre, maximum and probable.

It appears that of the 147,247 square miles of available mileage only 69,118, or 48 per cent, are really timbered.

The better class, Middle St. Lawrence type, being represented by 42,780 square miles, or nearly two-thirds, its large cordage of possible 10 and probable 8 cords per acre brings the average to 8.2 to 6.2, although in the other types the product runs mostly only between 5 and 3 cords. If we divide the total available acreage of country, 147,247 square miles, into the stated cordage of 363,603,200 cords, maximum or 288 million probable, we find that 3 to 4 cords per acre is an average figure which we can use for large territories of the type of Quebec.

In the St. Maurice Valley, of which the author has more intimate knowledge, the average on timbered area is stated as 6.75 cords, the best 8.6 cords, and the average over all 3.3 cords, with a percentage of balsam which runs from 48 to 78 per cent in different localities.

The valley of the St. Maurice River contains about 12,329 square miles and has all of the timber types of the province except the "Northern Subarctic." The area may be divided as follows:

	Square miles
Water	758
Merchantable timber	5,091
Lumbered	1,603
Swamp, not timbered	52
Burnt, reproducing spruce and balsam	2,873
Burnt, reproducing jack pine	656
Burnt, not reproducing	652
Settled	644
	12,329

Practically all of the timber is accessible, but there are some areas which cannot be lumbered profitably at present.

He estimates the total stand of timber at ten cords per acre over the "merchantable" area, giving 32,582,400 cords, and on the cut-over areas, at five cords per acre, 5,129,600 cords, or a total of 37,712,000 cords. This is made up as follows:

	Cords
Balsam	24,211,040
Black spruce	7,617,824
White spruce	5,883,072

The spruce timber is generally sound, but we must deduct about 10 per cent for rotten balsam, which would reduce the cordage to 35,290,-832 cords.

The cut in 1915 in this section was above 400,000 cords, an increase in the last five years of 28 per cent per annum. If only a 10 per cent increase of cut is anticipated for the future, the standing timber will be exhausted in 50 years, not counting loss by fire. "There is not sufficient timber left under the diameter limit set by the Government to produce within 30 years more than 3 to 5 cords per acre, and the figure is nearer three cords than five. The growth on the area lumbered each year from now on will not be sufficient to take care of the increased cut."

Not much hope is held out for a reproduction of the soft woods, except balsam, under present methods. Several tracts are cited which were burned fifty years ago on which there is to this day no reproduction of spruce or balsam, except a few scattered trees.

B. E. F.

The forest survey of the Province of New Brunswick is progressing, as is shown by the following account of the work accomplished before the resumption of the field work for this season.

Of a total of some 7,500,000 acres of Crown lands, 550,000 acres have been surveyed and examined by the field parties. The mapping and compilation have been completed for a total of 371,000 acres. Of this area, 76 per cent is covered with merchantable timber, less than 2 per cent with second growth of less than merchantable size, 11 per cent has been burned, but now contains young forest growth in sufficient quantities to replace ultimately the former forest, and on 9 per cent of the area mapped fires have caused such damage that satisfactory reproduction has been made impossible. Of the remaining 2 per cent, less than half represents the area of lands cleared or cultivated, and the balance is made up of caribou barrens, cranberry bogs, swamp land not supporting commercial growth, etc.

The cruise shows that the 282,064 acres of timbered land mapped to date contains 447 million feet of saw timber and 728,000 cords, equivalent to 364 million feet, of pulpwood, spool wood, etc. The grand total is thus 811 million feet, or an average of 2,900 board feet per acre.

If it be assumed that the 371,000 acres mapped to date is fairly representative of the 7,500,000 acres of Crown lands, the total stand will be in the neighborhood of 16 billion 220 million feet, estimated to be worth in stumpage at least $48,000,000. Mr. Caverhill, who has been in charge of the work, estimates that the harvesting and marketing of this crop will distribute among the people of New Brunswick not less than $300,000,000.

The legislature of the Province of Ontario has this year passed new legislation in an act to preserve the forests from destruction by fire. It provides for the creation of fire districts and the appointment of a Provincial Forester, which position Mr. E. A. Zavitz occupies, to execute the law. It provides for a close season from April 15 to September 30, during which the setting out of fires is to be under control by permit and gives authority to the Minister of Lands for taking other usual precautionary measures. An important feature is the charging of costs against the owner for any work that the Forester finds necessary to remove any danger, like burning debris, etc. Injunction by court proceedings is provided against railway companies neglecting the prescribed precautions. Co-operation with municipal councils in running down defaults against the law and for the recovery of costs are provided; and for the purpose of ready adjudication Crown timber agents or rangers may be appointed justices of the peace, and such justices may create a number of constables who can call on any citizen for assistance under penalty. Penalties are also imposed for throwing away burning matches, ashes, and for other offenses. Broad powers are given to the Provincial Forester.

Mr. Zavitz, with Mr. J. H. White as assistant, has organized the service under trying circumstances as regards securing personnel.

The Forest Products Laboratory of the Canadian Forestry Branch has prepared an interesting diagram on forest products from Canadian tree species, which groups the uses into four groups, namely, wood used as such, pulp and paper industry, distillation industries, minor industries, which latter is subdivided into direct, from trees (maple sap, gums, naval stores), extraction with solvents, hydrolysis, alkali fusion. Not less than 200 products are named as derivatives from tree growth, some few, to be sure, appearing in several places.

The *Canadian Forestry Journal* reports that recent experiments went to prove that sawdust is useful as a fire extinguisher. It was found to be very successful in quenching fires in oil, and much superior to sand for fires in tanks of inflammable liquids. Experiments were conducted with tanks of burning lacquer, though the same principles appear to apply largely to tanks of burning oil. The floating sawdust forms a blanket that shuts off the air from the flames. The sawdust blanket was completely successful in putting out the fires in these tests. It made no difference whether the sawdust was wet or dry.

The efficiency of sawdust is greater on viscous than on thin liquids, as it floats more readily on the former than on the latter. The sawdust itself is not easily ignited, and when ignited it burns without a flame, and the burning embers have not sufficiently high temperature to re-ignite the liquid. Mixing sodium bicarbonate with the sawdust increases its efficiency materially.

In April another 15,000 square miles of Quebec forest was brought under systematic protection against fire by the organization of the Laurentian Forest Protective Association, so that now altogether 75,000 square miles of the best and most accessible forest areas of the province are covered by the four co-operative associations—the Ottawa River, the St. Maurice, the Laurentian, and the Southern St. Lawrence.

The province contributes to the cost of patroling and fire fighting, but leaves the detail of appointing rangers and details of management in the hands of the associations. Ontario and British Columbia have adopted the opposite policy, relying upon taxing the licensees for fire protection by the Government direct.

The following instructions for forestry representatives attached to the so-called Forestry battalions—forestry students from Toronto—are of interest:

1. To locate, survey, and make a general reconnaissance of all forest areas acquired by the Home Grown Timber Committee for operation by the Canadian Forestry Corps.

2. Prepare detailed notes and sketch maps of the topography of said timber lands, together with location of mill sites, logging roads, camps, etc.

3. Traverse roads and prepare profiles where rendered necessary by heavy gradients.

4. To make a timber cruise of those areas and estimate amounts of merchantable timber, pit props, etc.

5. To investigate upon and report upon forestry methods and make recommendations as to reforestation, such as the most suitable and profitable species for various sites, soil studies, etc.

6. To prepare volume and increment tables, make growth studies, investigate absence or presence of the commercially important fungous diseases and insect pests.

7. To investigate utilization of forest and mill waste, such as brushwood, slabs, sawdust, etc.

8. To prepare progress reports of operations.

Some ten graduates and undergraduates are doing this kind of work, besides supervising logging and milling operations, scaling, etc.

Soon after the beginning of the war a need for Canadian wood-choppers, loggers, and millmen was experienced in Great Britain, and later in France, and so-called forestry battalions were organized for the purpose of converting British and French timber into lumber, railroad ties, material for trenches and roads, mining timbers, etc.

Four such battalions have been raised in Canada and have proceeded overseas, in addition to one battalion converted on arrival in England, and about 4,500 men supplied from drafts from various parts of Canada. Thus, all told, the number of men in Canadian forestry battalions totals more than 10,000, in addition to a large number of men already overseas who were formed into forestry companies. It is reported that all the forestry battalions have been fused into a corps, into which reinforcements are drafted from the medically unfit of the infantry.

While exploitation and not forestry was the object of these organizations, it is interesting to note that a number of Canadian foresters enlisted for this work and found useful employment of their technical knowledge, at least in Great Britain, in constructing volume tables, estimating and appraising timber, measuring materials, and even making forest descriptions and growth studies, the purpose of the latter serving hardly any immediate needs.

Following a recommendation by the Canadian Advisory Council for Scientific and Industrial Research, 100 square miles of the Petawawa Military Reservation, Ontario, has been set aside by the Militia Department as a forest experiment station, in co-operation with the Dominion Forestry Branch. This area comprises about two-thirds of the total reservation, all of which will still, however, be available for military purposes, so far as needed.

Petawawa is an artillery training camp, and a large portion of the reservation is ordinarily not needed for military purposes. It is situated in a typical white-pine district, and was almost completely logged off before the land was acquired by the Dominion Government. There is, however, a fine stand of young forest growth, in addition to a limited amount of larger material.

A considerable amount of cordwood is cut each year for camp use for fuel, etc., and the Forestry Branch will supervise this cutting ac-

cording to definite plans and will observe and record the results with a view to drawing conclusions as to silvicultural practice for the region, so far as practicable.

A party is now at work making a preliminary survey of the area set aside for forestry purposes. A type map will be prepared, and detailed studies will be made of volume and rate of growth, as well as of reproduction. It is hoped that scientific work of this character may be carried on from year to year and extended to cover other investigations appropriate to a regularly established forest experiment station.

The party now at work at Petawawa is under the charge of D. W. Lusk, who has been with the Dominion Forestry Branch for about three years, previous to which he was employed by the Laurentide Company, Limited, Grand Mere, Quebec. Mr. Lusk is assisted by four men, of whom two are returned soldiers. One of these, R. A. Courtnage, is an undergraduate of the Faculty of Forestry at Toronto University, who was a member of the Royal Flying Corps and was incapacitated for further military service by virtue of injuries received in an accident in England.

The British Development Commission's Report for 1915-16 shows that the war has not entirely interrupted its work. Most of the appropriations were made to continue research and undertakings already launched, excepting such as arise from the war, such as increase of food supplies and provision of plants for forestation purposes. For this last purpose a grant of $5,500 was made to the Commissioners of Woods; also $4,250 for maintenance of the demonstration area in the Forest of Dean.

A very readable popular article, entitled Nature Warfare in Field and Forest, by Ellen R. C. Webber, printed in *Canadian Forestry Journal* (June, 1917), gives an interesting account not of the enemies to vegetation in the animal world, but of the friends, which help to keep insect pests down and are often not recognized. Snakes, lizards, frogs, toads, lady-bugs, bees, wasps, and bumble-bees, skunks, bats, and night-hawks, owls, hawks, and other birds, especially the woodpecker, all come into their own as friends of man.

The controller of timber supplies of Great Britain has recently announced certain relaxations of restrictions on the import of timber from North America which it is hoped will to some degree stimulate the export of wood from this country.

It should be borne in mind, however, that bottoms in which to ship lumber are very scarce and insurance rates high, so that the increase in shipments may not be stimulated to any marked degree.

The new rules are as follows:

(1) Neutral sailers: Timber may be imported from Canada and the United States under provisions of an import license.

(2) Deck loads: General license granted by Department of Import Restrictions for import of timber as deck cargo from Canada and the United States. In this case it is unnecessary for importers to apply for licenses.

(3) Prices: The order which limits prices of imported softwood to those current during last week of January, 1917, is not to apply to timber imported from Canada and United States after July 19, 1917. Timber so imported may be sold by importers at cost price delivered to store, plus 10 per cent, provided price so calculated does not exceed by one-third the price occurring during last week of January, 1917, for softwood of similar quality in same locality.

In February of this year the well-known German forester, Dr. Heinrich von Fürst, died at the ripe age of 80. To American readers Forst Director v. Fürst was specially known on the literary side, as editor for many years of the *Forstwissenschaftliches Centralblatt* and by its best-known work, *Die Pflanzenzucht im Walde,* which experienced four editions, the most complete work in German on nursery practice. He was also responsible for the encyclopedia *Illustriertes Forst- und Jagdlexicon,* and for a revised edition of Kaushinger's *Forstschutz.* Among his many shorter articles which excelled in clearness and objective judgment, perhaps the most interesting to American readers is the controversial essay on *Plenterwald oder schlagweiser Hochwald,* in which a careful consideration of the selection forest leads to its condemnation in comparison with the uniform timber forest. For over 30 years v. Fürst was director of the forest school at Aschaffenburg.

PERSONAL

1. *Northeastern United States and Eastern Canada*

E. A. Sterling has resigned as manager of the trade extension department of the National Lumber Manufacturers' Association to take the position of manager of the new eastern office of James D. Lacey and Company, at 30 E. 42d street. Mr. Sterling will also take up some of his former consulting practice as part of the activities of this eastern office.

Dr. C. D. Howe, of the Faculty of Forestry, University of Toronto, this past summer has been investigating for the Commission of Conservation of Canada the extent to which cut-over pulpwood lands are reproducing valuable species in potentially commercial quantities, the effect of fire on reproduction, and other questions having reference to the reasonable expectation of another crop. The work was done in co-operation with the Forester of the Laurentide Company, Mr. Ellwood Wilson.

P. Z. Caverhill has resigned his position as Director of the New Brunswick Government Forestry Survey to take a position with the head office staff of the B. C. Forest Branch. Mr. G. H. Prince, who was Mr. Caverhill's assistant in the New Brunswick work, has succeeded him as director.

Prof. Samuel N. Spring, of Cornell University, has been appointed as lecturer at the Yale Forest School for the fall term. He will give the course in forest management.

Arnold Hansson, Yale Forest School 1917, has resigned from the Laurentide Company and entered the Medical Corps of the Canadian Army.

Director James W. Toumey, of the Yale School of Forestry, visited the various Forest Experiment Stations in the West during the summer.

Bristow Adams has been assisting in the food administrator's office in Washington during the summer.

The following men attended the meeting of the Association of Eastern Foresters at Bluff Point, N. Y., July 11-13: Filibert Roth, R. S. Hosmer, F. W. Besley, K. W. Woodward, R. C. Bryant, E. W. Graves, J. M. Briscoe, H. O. Cook, W. G. Howard, H. R. Bristol, F. F. Moon, S. N. Spring, C. R. Pettis, C. A. Davis, P. W. Ayres, B. A. Chandler, R. M. Ross, A. F. Hawes, R. G. Bird, C. P. Wilber, F. W. Rane, A. E. Moss, V. A. Beede, R. C. Hawley, E. G. Cheyney, A. B. Hastings, and A. B. Recknagel. Pettis and Roth also inspected the Axton plantations and cuttings.

2. *Central United States*

Ovid M. Butler, hitherto Assistant District Forester at Albuquerque, N. Mex., has been appointed as Assistant Director of the Forest Laboratory at Madison, Wis.

R. S. Kellogg, Secretary of the National Lumber Manufacturers' Association, lectured before the summer school of Cornell University. He said: "The various

associations of lumber manufacturers have had committeemen with power to act in close consultation with the government departments for the last two months. Practical specifications and reasonable requirements have been worked out and agreed upon and arrangements made to give government orders the right of way. Competent authorities estimate that this has resulted in a saving of millions of dollars to the Government and contributed greatly to the national defense."

A. W. Schorger has resigned from the Madison Laboratory to go into private work along similar lines.

3. *Northern Rockies*

Fred R. Mason, lumberman, resigned from the Forest Service on July 25, 1917, to enter the employ of the Polleys Lumber Company, of Missoula, Mont. Mason has been with the Service since his graduation from Yale, in 1911, and since 1914 has been a member of the logging engineering staff in the district office in Missoula. His new duties will be along similar lines.

H. N. Knowlton, in charge of products, District 1, with headquarters at Missoula, has been indefinitely detailed to the Washington office to assist on extra work being done for the War Department. His place in the district office is being temporarily filled by C. N. Whitney, of the Deerlodge Forest.

4. *Southwest, including Mexico, Central and South America*

H. H. Chapman, who holds the chair of Forest Management at Yale University Forest School, has been granted leave of absence on account of his wife's health. He is now at Albuquerque, N. Mex., in charge of the district office of silviculture.

Forest Supervisor Don P. Johnston, who has been in charge of the Chiricahua-Coronado National Forest for more than a year past, with headquarters at Tucson, Ariz., was transferred about June 15 to the district forester's office at Albuquerque as assistant district forester in charge of operation. Before going to Tucson Mr. Johnston had been Supervisor of the Santa Fe and Gila National Forests of New Mexico. He succeeds Assistant District Forester A. O. Waha, who, after an experience of many years in the National Forests of the Southwest, has been transferred to the Forester's office in Washington, D. C. Mr. Johnston is succeeded at Tucson by Forest Supervisor Paul P. Pitchlynn, of the Sitgreaves National Forest, with headquarters at Snowflake, Ariz. Mr. Pitchlynn, before being appointed Supervisor of the Sitgreaves Forest, had a wide experience in various branches of technical work throughout the National Forests of the Southwest.

5. *Pacific Coast, including Western Canada*

W. J. Van Dusen (B. Sc. F., Toronto, 1912), for the past four years in the service of the B. C. Forest Branch at Victoria, and of late acting as assistant forester, has been transferred to Vancouver to become district forester at that point.

C. A. McFayden (B. Sc. F., Toronto, 1912), formerly with the Dominion Forestry Branch in British Columbia, is now district forester for the B. C. Forest Branch at Fort George.

C. A. Lyford has resigned from the firm of Clark & Lyford, Ltd., of Vancouver, B. C., to become the chief forest engineer of James D. Lacey & Co., with headquarters at Seattle, Wash.

The University of California's Division of Forestry has been hard hit by the war. D. T. Mason and Donald Bruce have gone to France with the Tenth Engineers. M. B. Pratt has resigned, leaving only Mulford and Metcalf of the original staff.

C. Stowell Smith, hitherto Chief of Products in District 5 of the Forest Service, has been appointed Secretary of the California Sugar and White Pine Association, with headquarters at San Francisco.

Engineer R. R. Randall has been detailed to District 6 from the Washington office, to handle water-power business in the absence of Mr. Lundgren, and assist in road work.

Among the forest officers of District 6 who have enlisted in the 10th Reserve Engineers (Forest) are the names of Deputy Supervisor W. K. Ramsdell of the Wenatchee, Rangers Raymond Thompson and Harry Elliott of the Colville, and C. J. Kraebel of the Columbia.

Captain Leonard Lundgren and H. S. Ward, Master Engineer Junior Grade, of the District 6, have been called into active service with the First Separate Battalion Oregon Engineers.

Forest Examiner W. H. Gibbons of District 6 left for Washington, D. C., in July, on his way to France for professional forestry work in connection with the 10th Reserve Engineers (Forest) Regiment, which is made up of foresters and woodsman.

Forest Examiner C. W. Gould, of District 6, has been detailed to the Forest Products Laboratory at Madison, Wisconsin. Moritz L. Mueller, formerly of Portland, has also gone to Madison for special work in the laboratory.

6. *Hawaii, the Philippines, and the Orient*

A. S. Fisher is holding down the position of Director of Forestry in the Philippines. W. F. Sherfesee is still in China (June 29).

L. R. Stadtmueller, who is with the China Import and Export Lumber Co., Shanghai, is on a three months' trip in the interior of China investigating the lumber situation.

A Forest Regiment to France

The roster of commissioned officers in the "forest regiment," or, as the War Department designates it, the Tenth Reserve Engineers (Forest), has been announced and includes two regular army officers, fifteen foresters from the U. S. Forest Service and two from the Forest Branch of British Columbia, one lumberman from the Indian Forest Service, and thirteen foresters and lumbermen taken from private or institutional work.

The War Department has designated Lieut. Col. James A. Woodruff, of the Engineer Corps, to organize and command the regiment, and Beverly C. Dunn, Captain of Engineers, as Adjutant. W. B. Greeley, Assistant Forester, in charge of the Branches of Silviculture and Research, U. S. Forest Service, has been commissioned as Major in charge of lumber operation and supervision of the

entire work. Geo. L. Wood has been commissioned as Major in the capacity of lumber operator. Swift Berry, of District 5, as a logging engineer. W. H. Gibbons as assistant logging engineer. Prof. Donald Bruce, of the University of California, is in charge of a party of six forest assistants to do timber reconnaissance work in France. Professor Woolsey has been designated as timber negotiator. A. S. Peck, of the Forest Service, has been commissioned as Major to act in the capacity of organization expert. Fred B. Agee as trained (maintenance) clerk. Coert Du Bois, district forester in charge of the National Forests of California, has been selected to serve as Major on the regimental staff and to aid in the organization and equipment of the regiment. The remaining officers are as follows:

Majors in command of battalions: R. E. Benedict, assistant forester in the Forest Branch of British Columbia, and C. S. Chapman, manager of the private timber protective associations of western Oregon.

Captains: Edward S. Bryant, forest inspector, U. S. Forest Service, stationed at Washington, D. C.; Inman F. Eldredge, forest supervisor of the Florida National Forest, stationed at Pensacola, Fla.; J. D. Guthrie, forest supervisor of the Coconino National Forest, stationed at Flagstaff, Ariz.; Evan W. Kelly, forest examiner, U. S. Forest Service, stationed at San Francisco; John Lafon, assistant forester in charge of timber operations, Forest Branch of British Columbia; David T. Mason, professor of forestry at the University of California; W. N. Millar, professor of forestry at the University of Toronto; Barrington Moore, a private forester from New York City; Arthur C. Ringland, forest inspector, U. S. Forest Service, stationed at Washington, D. C.; Dorr Skeels, logging engineer and professor of forestry at the University of Montana. The three captains taken from university professorships are, it is stated, chosen because of their extensive past experience in practical lumbering and other woods work.

First Lieutenants: Risden T. Allen, of the Allen-Medley Lumber Company, Devereux, Ga.; M. S. Benedict, forest supervisor of the Sawtooth National Forest, stationed at Hailey, Idaho; Robert L. Deering, forest examiner, U. S. Forest Service, stationed at Albuquerque, N. Mex.; Clarence R. Dunston, lumberman, U. S. Indian Service, stationed at Dixon, Mont.; D. P. Godwin, forest examiner, U. S. Forest Service, stationed at San Francisco; J. G. Kelly, lumberman, of Portland, Ore.; Eugene L. Lindsay, forest examiner, U. S. Forest Service, stationed at Washington, D. C.; E. C. Sanford, forest supervisor of the Idaho National Forest, stationed at McCale, Idaho; H. C. Williams, who recently resigned from the supervisorship of the same forest; Stanley L. Wolfe, forest examiner, U. S. Forest Service, stationed at Washington, D. C.; J. B. Woods, of the Arkansas Land and Lumber Co., Malvern, Ark.; Herman Work, deputy forest supervisor of the Caribou National Forest, stationed at Montpelier, Idaho.

Second Lieutenants: H. R. Condon, forester with the Pennsylvania Railroad, Philadelphia; S. H. Hodgman, logging camp foreman with the Potlatch Timber Co., Potlatch, Idaho; W. H. Gallaher, forest examiner, U. S. Forest Service, stationed at San Francisco; J. W. Seltzer, forester with the New Jersey Zinc Co., Franklin, N. J.; H. B. Shepard, forester with the Lincoln Pulp Co., Bangor, Me.; E. F. Wohlenberg, forest examiner, U. S. Forest Service, stationed at Flagstaff, Ariz.

University of Washington Foresters in the War

List 1.—Commissioned Officers:

Anderson, A. C., ex. '17, 2d Lieut., Regular Army. Ft. Leavenworth, Kans.

Bonney, Parker S., '13, Sub-lieut., H. M. S. *Hermonie.* South Hampton, England.

Brindley, Ralph, '17, 2d Lieut., Artillery (R. O. T. C.). American Lake Encampment.

Clark, Donald H., '17, 1st Lieut., Artillery (R. O. T. C.). American Lake Encampment.

Gibbons, W. H., ex. '10, 2d Lieut., Forestry Regiment. Somewhere in France.

King, Robt. F., '19, 2d Lieut., Coast Artillery.

MacKechnie, A. R., '18, 2d Lieut., Regular Army.

Murphy, E. C., '20, 2d Lieut., Regular Army Reserve list. Seattle.

Alexander, J. B., ex. '17, 1st Lieut., Aviation Corps. San Diego.

Bloom, Adolph, ex. '16, Ensign, Naval Training Station. University of Washington Campus.

Sanger, Owen J., short course, '14 and '15, 1st Lieut., Canadian Contingent. Somewhere in France.

Young, L. P., '17, 2d Lieut., Infantry (R. O. T. C.). American Lake Encampment.

List 2.—Non-commissioned Officers:

Billingslea, J. H., '14, Top Sergeant, Forestry Regiment. Washington, D. C.

Fifer, Chas., '20, Sergt. Chauffeur, Quartermaster's Corps. American Lake Encampment.

Wilcox, J. M., '20, Corporal, Infantry.

List 3.—Forestry Regiment (starred names repeated elsewhere):

*Billingslea, J. H., '14, Top Sergeant. Washington, D. C.

Broxon, Donald, '14 (?).

Crumb, Isaac J., '20 (Private ?). Washington, D. C.

*Gibbons, W. H., ex. '10, 2d Lieut. Somewhere in France.

Graham, Paul, '13 (Private ?). Washington, D. C.

Larson, Arthur K., short course, '16 and '17, Private. Washington, D. C.

McGillicuddy, Blaine, short course (?).

Russell, Jos. P., ex. '18 (?).

Schmaelzle, Karl J., ex. '15, Private. Washington, D. C.

List 4.—Battery A, Washington Signal Corps:

Brady, Chas. C., '18.

Browning, Harold, '17.

List 5.—University of Washington Ambulance Corps:

All in this list now at Allentown, Pa. This corps is being held here to act as instructors.

Bernhardt, Carl L., '18.

Roberts, Wesley K., '18.

Wirt, William, '18.

List 6.—Engineers:

Bevan, Arthur, ex. '17, Sapper, Tunneling Section, Canadian Eng. Somewhere in France.

Foran, Harold, '16, Private, 18th U. S. Engineers. Buffalo.

Powers, Victor S., '18 (?).

Schmitz, Henry, '15, First-class Machinist, U. S. Naval Reserves.

Van Wickle, J. M., '18 (?). Somewhere in France.

Powell, Harry A., short course, '14 and '15, Draughtsman, English Army, in France.

List 7.—In Training Camps:

Burnham, R. P., '17, 2d R. O. T. C. Presidio, San Francisco.

Harmelling, H., ex. '12, R. O. T. C. Presidio, San Francisco.

Cameron, J. F., '19. Aviation Training Camp, San Diego.

Garrett, C. B., '16. Naval Training Station, Univ. Wash. Campus, Seattle.

Odell, W. T., ex. '12. Aviation Training Camp, Yaphank, Long Island, N. Y.

Stanton, L. G., '18. Aviation Training Camp, San Diego.

List 8.—Miscellaneous (or division of service not known):

Evans, Vincent, '16 (Forestry ?).

Calvert, Gerald F., short course (?), Canadian Contingent. Somewhere in France.

Charlson, Alex., short course, '16, Canadian Contingent. Somewhere in France.

Fisher, David, ex. '14 (Forestry?).

Fish, Harold, '18 (Private, Forestry ?).

Plummer, Donald, '20, Private, Coast Artillery.

Rees, H. A., short course, '14, Canadian Contingent. Killed in battle in France.

Rees, L. A., short course, '14, Canadian Contingent. Killed in battle in France.

Thompson, Jackson, short course, '16, Canadian Contingent. Somewhere in France.

The above list, while not complete, is fairly accurate, with the exception of the present location. It is also very probable that a number of the Canadians who enlisted at the beginning of the war have been promoted in rank.

CONTENTS

Vol. XV NOVEMBER, 1917 No. 7

JOURNAL OF FORESTRY

OFFICIAL ORGAN OF THE SOCIETY OF AMERICAN FORESTERS

COMBINING THE PROCEEDINGS OF THE SOCIETY AND THE FORESTRY QUARTERLY

PUBLISHED BY THE
SOCIETY OF AMERICAN FORESTERS
AT 930 F STREET N. W.
WASHINGTON, D. C.

Single Copies, 50 Cents Annual Subscription, $3.00

Entered as second-class matter at the postoffice at Washington, D. C., under the act of March 3, 1879

JOURNAL OF FORESTRY

A professional journal devoted to all branches of forestry

EDITED BY THE EDITORIAL BOARD OF
THE SOCIETY OF AMERICAN FORESTERS

The Journal appears eight times a year—monthly with the exception of June, July, August, and September.

The pages of the Journal are open to members and non-members of the Society.

Manuscripts intended for publication should be sent to Prof. B. E. Fernow, at the University of Toronto, Toronto, Canada, or to any member of the Editorial Board.

Missing numbers will be replaced without charge, provided claim is made within thirty days after date of the following issue.

Subscriptions and other business matters may be addressed to the Journal of Forestry, Atlantic Building, 930 F Street N. W., Washington, D. C.

JOURNAL OF FORESTRY

VOL. XV NOVEMBER, 1917 NO. 7

SOME FACTORS INFLUENCING THE REPRODUCTION OF RED SPRUCE, BALSAM FIR, AND WHITE PINE

By BARRINGTON MOORE

CONTENTS

PURPOSE OF INVESTIGATION

The purpose of the present investigation was to learn something concerning the factors governing the reproduction of the more important coniferous trees of northern New England. The study was confined to a single locality, because detailed investigations of small areas will yield fundamental knowledge of forests more quickly than general studies of large areas.

LOCALITY

Location

The study was carried out on the island of Mt. Desert, the largest of the many islands off the southern coast of Maine. This island, on account of its location and unusual topography, offers more of interest to ecologists and foresters than almost any other area of the same size in eastern United States. Mt. Desert is roughly oval in shape and almost cut in two by a long, narrow inlet. It is approximately 12 miles wide by 16 miles long.

Hawley and Hawes[1] include the island in the northern spruce region; in reality it is at the edge of this region and contains several features of the white-pine region. This location in the tension zone between two forest regions offers unusual opportunities for studying succession in forest types and for determining whether or not the northward migration of plants which followed the retreat of the ice-sheet is still going on.[2] Fortunately the setting aside of 5,000 acres of the island as a national monument will permit the making of long-time studies covering these and other matters of interest to foresters and ecologists.

The topography is of the most varied, from a rolling plain to almost sheer precipices nearly a thousand feet in height. This offers, as may readily be imagined, a wealth of habitats.

Climate

The climate is marine, the ocean tending to keep the temperature uniform but cold, for the island lies beyond the influence of the Gulf Stream. Parts of the island are, however, so shut off from the ocean winds as to have a climate almost continental and are subject to considerable fluctuations in temperature. The large areas of granite rock (see geology below) take up and radiate enormous quantities of heat, causing temperature fluctuations which, particularly in places protected from the ocean winds, must have a distinct bearing on the vegetation. The mean annual temperature at Bar Harbor is 44° F., running from a monthly mean of 21° for January to 65.5° for July.

The average annual precipitation is 48.3 inches, of which only one-third, or 16.1 inches, comes in the growing season (May to September, inclusive). Although this amount should be more than ample, there are periods during the summer when lack of moisture is an important factor in coniferous reproduction, especially on rocky sites.

Geology

A brief glimpse of the geology[3] of the island will aid in understand-

---

[1] Hawley, R. C., and Hawes, A. F.: "Forestry in New England." New York, 1912.

[2] Griggs, R. F.: "Observations on the behavior of some species at the edges of their ranges." Bull. Torrey Botanical Club 41: 25-49, 1914. See especially p. 47. For indications of this phenomenon on Mt. Desert Island, see under "The Vegetation, General," p. 830.

Gleason, H. A.: "The vegetation of the inland sand deposits of Illinois." Bull. of the Ill. State Lab. of Nat. Hist., Vol. 9, article 3, pp. 23-174, 1910. Especially pp. 44 and 45.

[3] Davis, Wm. M.: "An outline of the geology of Mt. Desert." In Rand and Redfields "Flora of Mt. Desert Island, Maine," pp. 44-71, Cambridge, Mass., 1894.

Shaler, N. S.: "The geology of the island of Mt. Desert, Maine." Report Secretary of Interior to 1st Session of 50th Congress, Vol. 3, part 2, pp. 987-1063, 1889.

ing the habitats. The periods of the different outcrops have not been determined with exactness, but are unnecessary for our purpose. It appears that after long periods of deposition, diversified by volcanic action, a large mass of granite was forced up into the strata. Whether this granite ever reached the surface or not is unknown, for the highest points now remaining were far beneath the surface and have been laid bare by erosion. This granite was in turn penetrated by numerous trap dikes, which also never reached the surface, so far as we know. The granite now comprises practically all of the higher parts of the island and extends to the sea. The rocks into which the granite was forced are mainly metamorphosed quartzites and shales, with small areas of lava (felsite) which seem to have come to the surface during the periods of deposition before the intrusion of the granite. These non-granitic rocks form the lower parts of the island, but are of considerably less importance than the granite because they are largely mantled with glacial till except along the steeper parts of the shore and on low knolls on the northern part of the island.

The geological events which have left their imprint most strongly on the present habitat are the ice-invasion and subsequent submergence. The ice polished and cut great gashes in the granite range which forms the backbone of the island. It swept away the soil and in its place left an incomplete mantle of stony till.

The submergence following the ice-invasion removed the till from all but the gentler slopes and level areas, leaving the granite hills almost bare of soil. On these hills only occasional small depressions and the gentler northern slopes retain part of their covering of till.

Geologists do not agree as to the extent of the submergence, Davis admitting the 220-foot shoreline, but doubting the others. Shaler's evidence is strong and corroborated by a number of stretches of shoreline in addition to those he visited. Shaler claims that the submergence covered the summit of the highest point (Green Mountain, 1,527 feet). During the subsequent uplift of the land the sea did not stand long enough at one level to cut in very deeply, except in two places, one at about 480 feet and the other at 220 feet above its present level. Above 480 feet, wherever the slope is steep enough to have given the waves a chance to cut, there are distinct terraces and cliffs, some of them small, but almost certainly due to wave action. The geological history of the island has therefore a direct bearing on the present vegetation. Although the formations are old, the physiography is young and affords many opportunities for studying pioneer associations.

Soil

On the hills the only soil, except in the hollows and on the gentler slopes, is a layer of "duff" or plant remains which has escaped the frequent fires. These remains are as yet largely undecomposed and form what Coville[4] calls "upland peat," which is unlike ordinary peat in that it is not formed in bogs and seems to be due to lack of warmth rather than to lack of air. In the forest, except on recent burns, this "upland peat," or "duff," covers the soil as well as the rock.

The lower lying portions of the island are covered with a mantle of rocky reddish-brown glacial till of varying thickness. Some of the hollows just above sealevel contain deposits of blue clay which Shaler attributes to sea deposition during the postglacial submergence.

THE VEGETATION

General

The flora of the island is predominantly northern, with a strong admixture of southern elements. This combination is of unusual interest and affords, as I have said, an excellent opportunity to study the northward migration of southern plants if, as some botanists[5] have shown, this northward migration is still going on. The question is too large to go into fully here, and will require intensive study covering long periods of time before it can be definitely settled. But observational evidence tends to corroborate the view that there is such a northward movement, and, from the larger viewpoint of time, that this movement is proceeding at a fairly rapid rate. For example, red oak (*Quercus rubra*) is one of the prominent forest trees of southern New England and comes up into the spruce forests of northern New England only as scattered individuals. Yet there are places on Mt. Desert Island where the red oak occurs as scattered individuals in the main stand, but comprises a large proportion of the reproduction under the stand. Here the next generation of the forest will probably be largely red oak. Further study is necessary to determine if this increase of oak is temporary or is part of a northward migration of the tree. The establishment of southern forms is probably favored by the abundance of steep south exposures which receive strong insolation and are protected from rapid fluctuations of temperature by the proximity of the sea. It would be extremely interesting to know why on this island and on Schoodic Point, on the mainland five miles to the east, we find isolated stations

---

[4] Coville, F. V.: "Experiments in blueberry culture." U. S. Dept. Agriculture, Bureau of Plant Industry, Bull. 193, 1910.

[5] See citations given under note 2.

of jack pine (*Pinus divaricata*). On Schoodic Point the tree is abundant and is reproducing itself, though whether it is spreading or not is difficult to say for certain; on Mt. Desert two trees were found growing on a granite ridge swept bare of other trees by fire.

The island also contains surviving colonies of Arctic flora, probably left stranded there after the retreat of the ice.

The first characteristic of the vegetation to strike the casual observer is the dominance of spruce (*Picea rubens*). The tree not only forms a nearly pure spruce association, but occurs in all the other types in greater or less abundance. It is the universal matrix of the forest cover.

Red spruce is not the only spruce native to the island; the white spruce (*Picea canadensis*) is also common. The latter is, however, seldom found in the natural forest, occurring chiefly on the better soils near the sea along the northern part of the island. The factors favoring the white spruce are hard to determine on account of human interference on most of its site.

The forest associations or types on the island are rather difficult to portray because of the vagueness of the line of demarkation between them. One association merges insensibly into the next. Exceptions are the pitch pine (*Pinus rigida*) and the gray birch-aspen associations, both of which are quite distinct and are sharply separated from all others. The chief associations, both from the point of view of forest value and area covered, are the spruce, the white pine, and the cedar. Each of these trees forms a distinct association, with of course other trees in mixture on certain distinct sites. But over a large part of the island the three trees mingle in varying proportions in a rather disconcerting manner. The complexity is probably attributable, in part at least, to the struggle between the vegetation of the northern spruce region and that of the white-pine region. For rough descriptive purposes it would probably suffice to recognize a spruce association and a mixed conifer association, the latter composed of a variable mixture of spruce, white pine, and cedar. But a better conception of the factors underlying the forests will be secured by dividing the mixed conifer association into the white pine and cedar associations which, together with the spruce association, are the three distinctive units which so frequently merge and tend to obscure the true character of the forests of the island.

Spruce Association

Composition.—The characteristic spruce association is composed of nearly pure spruce, but any forest containing 6 per cent or more of

spruce would fall under this classification. The chief coniferous associates of the spruce are balsam fir (*Abies balsamea*), white pine (*Pinus strobus*), white cedar (*Thuja occidentalis*), hemlock (*Tsuga canadensis*), and sometimes a little red pine (*Pinus resinosa*). All of these trees do not occur together with the spruce; all may be present, but sometimes one or more is lacking. Fir, white pine, and white cedar are seldom absent, and hemlock is not uncommon, but is not often found with all the others. The broadleaf associates are red maple (*Acer rubrum*), paper birch (*Betula papyrifera*), yellow birch (*Betula lutea*), occasional aspen (*Populus tremuloides* and *grandidentata*), and sometimes, but not often in this locality, a beech (*Fagus americana*), and still more rarely a sugar maple (*Acer saccharum*). The proportion of broadleaf trees, except beech and maple, appears to bear a more or less distinct relation to the age of the stand, the younger stands having more broadleaf trees than the older ones. This is but natural in that after a fire the broadleaf trees, especially the light seeded and intolerant aspen and birch, have an opportunity to establish themselves; later the spruce comes up, crowds out the broadleaf trees, and by its dense shade prevents their establishment. The beech and maple are sufficiently shade enduring to be able to compete with the spruce and to maintain themselves in the older stands. On this island beech is fairly common in the older forests; maple is rare except in the cool and moist ravines.

The understory, aside from reproduction, varies with the density of the overhead canopy. The commonest shrubs are moosewood maple (*Acer pennsylvanicum*), hobble bush (*Viburnum alnifolium*), and mountain maple (*Acer spicatum*). There are also numerous herbs which alone would give ample material for an extended study in the relation of plants to habitat.

Occurrence.—The spruce association grows on the poorer rockier sites, often covering areas devoid of soil except for the layer of moss and "duff" derived from plant remains. This layer can often be lifted like a blanket, exposing the bare rock beneath. But though the soil may be extremely poor or even lacking, there must not be strong insolation. The association never occupies the warm south aspects, seeming to prefer the vicinity of the sea where it gets the fogs, apparently not suffering much from the strong winds. The association, though abundant, does not cover extensive stretches of land, but is constantly interrupted by the white pine or the cedar associations or by burns filled with gray birch and aspen.

Distribution of Age Classes.—One of the most important features

of an association is the distribution of the age classes, for on this depends to a large extent the method of cutting. Hitherto this feature has been too often overlooked, even by foresters. The spruce association on Mt. Desert Island is even-aged in groups, the size of the groups varying from one or two trees to half an acre or more. A small opening, created by the death of one or two large trees, will fill up with reproduction and develop into a small group; a large opening, made by windfall or some other agency destroying a considerable number of trees, will form a larger group. When the stand has been destroyed by fire, the first generation (after the birch and aspen stages) is rather open. Eventually the open spaces fill in, giving a two-aged or sometimes uneven-aged forest. Later on, as the stand becomes older, the differences in age become less apparent and we have again, for all practical purposes, an even-aged stand. This is true not only of red spruce in the east, but also of Engelmann spruce in the Rocky Mountains.

Reproduction.—Reproduction is abundant in all openings. In small openings spruce predominates, though generally accompanied with a little fir. There are spruce seedlings even under the main canopy, where there is very little light; and they persist for a long while, making imperceptible growth, but keeping alive. If the stand is opened up they will grow, unless the opening permits the ground to dry to such an extent that they are killed. In moderate-sized openings other species often outnumber the spruce. Fir seems to be the first tree to take advantage of such openings and often predominates. In larger openings white pine, and sometimes even red pine, may come in, but as the canopy closes again the spruce seems to be the only one which continues to reproduce. Hence it will eventually regain the mastery on sites favorable to it.

White-pine Association

Composition.—The white-pine association at its best, in central New England, Pennsylvania, and the Lake States, is composed of nearly pure white pine. There is little of this on Mt. Desert Island, although considerable areas are covered with a forest in which 50 per cent or more of the trees are white pine (*Pinus strobus*). It seems better to class these forests as white pine than to make associations for every local variation. Most of the white pine contains a large proportion of red spruce and considerable amount of white cedar. The chief deciduous tree in mixture is gray birch (*Betula populifolia*); paper birch (*Betula papyrifera*) is found only in the cooler situations where white

pine gives way to spruce. Red maple is also a common tree, aspen is not infrequent, and cherry (chiefly *Prunus pennsylvanica,* with some *P. serotina*) is abundant, but seldom reaches tree size.

Portions of the white-pine association are composed of white pine and red pine, the latter having possibly come in after ancient fires. Here white-pine reproduction, mixed with young spruce and cedar, is abundant, and red-pine reproduction is scarce. There are patches in which spruce predominates, with cedar next in abundance and an occasional hemlock; near by are odd mixtures of white pine, red pine, hemlock, spruce, and cedar all growing together in the main canopy, with dense spruce and cedar reproduction underneath.

Evidence favors the hypothesis that this white pine-red pine stand with reproduction of white pine, spruce, and cedar is a temporary association or stage in a fire-started succession leading to the spruce association. But the abundance of white-pine reproduction shows that the final result, though it may be spruce, will yet contain a large proportion of white pine. This in itself is an indication of the encroachment of white pine on spruce, and perhaps throws light on how the encroachment takes place.

On some of the rock ledges there occurs a mixture of stunted white and red pine which appears to owe its origin to the poverty of the site rather than to fire. In this kind of forest red oak and gray birch are common associates.

The understory is far richer in number of species and variety than that of the spruce association. The more conspicuous shrubs are blueberry (*Vaccinium pennsylvanicum* and *V. canadense* L.), huckleberry (*Gaylussacia baccata*), and sheep laurel (*Kalmia angustifolia*). There is also some wild rose, some blackberry, and a little high-bush blueberry.

Occurrence.—The white-pine association grows on warmer, and also perhaps drier, sites than the spruce. The character of the soil seems to be a matter of indifference, and white pine sometimes, though less often than spruce, grows on nearly bare rock. The bare rock of the moister sites is occupied by spruce, and that of the drier sites is too dry for white pine and is left to the pitch pine (*Pinus rigida*).

Distribution of Age Classes.—The association is, in general, approximately even-aged. In mixtures with spruce the pine far overtops all other trees. This does not mean that it is older. Its demand for light compels the pine to dominate or at least to occupy an important place in the upper canopy, its rapid growth enabling it to fulfill this requirement. The cedar, though shade-enduring and often of the understory, establishes itself in the open with the pine and spruce.

Reproduction.—The reproduction has been touched upon under composition. The most conspicuous tree in the young growth up to about 3 feet high is perhaps balsam fir; it is everywhere, even though there are no fir seed trees within apparent reach. Closer examination shows, however, that the fir is relatively infrequent in the younger reproduction, less than five years old. Furthermore, the high mortality of the fir after reaching the sapling stage makes it seem probable that fir will be inconspicuous in the main stand of the next generation. Next in abundance in the reproduction is white pine. It is thrifty and promising and comes in heavily in some years and not at all in others. Except where white pine is nearly pure, spruce and cedar play a conspicuous part in the reproduction, the spruce alone often equalling the young white pine even where the main stand is predominantly pine. There is, it seems, a struggle between pine and spruce, the latter holding the advantage because of its ability to survive under the shade of the former, but the pine nevertheless holding its own and perhaps even encroaching on the domain of the spruce.

Cedar Association

Composition.—The composition of the cedar association, like that of the two foregoing associations, is variable; white cedar (*Thuja occidentalis*) predominates, but never forms pure stands, as does the spruce and white pine. Over much of the island the cedar association merges with the spruce and also, though to less extent, with the pine. Considerable areas of it contain scattering large white-pine trees. The chief associates are fir, spruce, and white pine among the conifers and red maple, white birch, and aspen among the deciduous trees. The proportions of spruce vary considerably and often change gradually from place to place, causing the cedar to merge imperceptibly into the spruce association. White pine is often abundant, but the line of demarkation between the white pine and cedar associations is always more distinct than that between the cedar and the spruce. The white pine appears to be a relic of the days when the stand was more open, as after fire or some other accident, and not a permanent component of the stand.

Occurrence.—The cedar association occurs only on moist sites and is the characteristic forest of the wet, swampy flats. On the sites and in every little moist hollow cedar tends to crowd out all other competitors. It also comes in, sometimes even predominating, on rocky ledges, probably where there is abundant moisture from higher up the slope.

Distribution of Age Classes.—The cedar association seems to be even-aged, though we would expect the contrary on account of the shade-enduring qualities of cedar. Its shade endurance is considerably less than that of spruce, but almost if not quite equal to that of fir and considerably greater than that of white pine. It may be, therefore, that the even-aged character of the stands on Mt. Desert is due largely to their youth, and that if undisturbed for a long while they would become more or less uneven-aged.

Reproduction.—The reproduction in many parts of the cedar association appears to be predominantly fir. This is because fir is the most conspicuous growth among the large seedlings up to about 2 or 3 feet in height. Mixed with the fir there is much cedar and some spruce; among the smaller seedlings cedar generally predominates and fir is almost lacking. It is probable that the fir will diminish greatly before the present generation of cedar dies off, and that the next generation will contain about as high a percentage of cedar as the present one. Spruce is fairly abundant under the main canopy; white pine is of importance only in the larger openings and where the stand has been destroyed by fire or injured by cutting.

Pitch-pine Association

The pitch-pine (*Pinus rigida*) association is generally composed of pure pitch pine, though frequently it contains an admixture of red pine, and less commonly of red pine and white pine. Sometimes we find a mixed association of pitch pine and white pine, which, however, can generally be classed as either pitch pine or white pine, according to the one which predominates. On the steep, rocky slopes bearing both of these pines we sometimes find cedar in the crevices, together with red oak and red maple, and also occasional clumps of alder; but ordinarily cedar is not a common associate of pitch pine.

The characteristic ground cover of the more open portions of the pitch-pine associations is ground juniper (*Juniperus communis*), which often forms dense mats between the pines. The more nearly fully stocked stands are undergrown thickly with huckleberry (*Gaylussacia baccata*). Among the first plants to start on the rocks between the pines are blueberry (*Vaccinium pennsylvanicum*) and the attractive little three-toothed cinquefoil (*Sibbaldiopsis tridentata*), which in the autumn aids in giving a beauty of coloring almost unsurpassed. Braken fern, partridge berry (*Mitchella repens*), and wintergreen (*Gaultheria procumbens*) are among the other plants common to this association.

Occurrence.—The pitch pine is without doubt the most xerophytic

forest association of the island. It occupies the rocky, dry, warm sites, apparently confined to them by the competition of other trees on the better sites. Strangely enough, it occurs also on granite ledges just above the sea, exposed to the full sweep of the east wind, probably because these ledges, in spite of the proximity of the sea, are dry and fairly warm. On the whole, owing to the unfavorable sites on which it grows, this pitch pine is too short, limby, and small to be of commercial value, running only about 15 to 20 feet in height by about 6 to 10 inches in diameter. It has nevertheless, especially where it is twisted by the wind, a picturesque charm.

Distribution of Age Classes.—The stand grows in even-aged groups, composed of from one to many trees, as the result of the way in which it originates. On the worst sites it starts as scattered trees or clumps of trees here and there, giving small, even-aged groups. In a less unfavorable place, as on a rocky flat, a group of considerable size may come in, forming an approximately even-aged forest.

Reproduction.—The reproduction in this association consists of scattered pitch pines of various ages in most of the openings. Where it is nearly fully stocked, scattered seedlings occur under the light shade of the parent trees, but are not abundant. In some of the better sites there are seedlings of white pine and a few clumps of small fir and spruce, indicating that here the pitch pine is a pioneer association which sooner or later will probably give way to spruce.

Gray Birch-Aspen Association

Gray birch and aspen, the former predominating, make a temporary cover after the destruction of the forest by fire. Both trees are short, seldom reaching more than 15 feet in height, grow close together, and often form dense thickets. On the moist and cool sites gray birch is replaced by paper birch (*Betula papyrifera*) and yellow birch (*B. lutea*), which grow to be fair-sized trees.

The reproduction is seldom of birch or aspen, but of the conifers which formed the original forest, and the abundance of this coniferous reproduction depends largely on the number and distribution of seed-bearing trees which have escaped fire. In a few places the reproduction is abundant enough to give a fully stocked stand after it has crowded out the birch and aspen; more frequently it is sparse and will give an open stand, which will gradually fill in from the seed of the trees which are now only seedlings. In some places there have been second fires which, destroying the coniferous reproduction, enable the birch and aspen to maintain possession for a considerably longer time, until gradually crowded out by encroachment from the edges.

Minor Associations

Red Pine.—Red pine often grows in mixture with the pitch pine, but almost as often forms a distinct but small association at the edge of the pitch pine, where there is more soil or more moisture. This association is interesting as affording an opportunity for studying the factors governing red pine as compared with those governing white pine and pitch pine. So far as could be ascertained from general observations, red pine is intermediate between the white and the pitch, but more nearly related in its requirements to the former. Curiously enough, red pine is uncommon in the white-pine region adjacent to Mt. Desert Island,[6] and occurs only scatteringly in the spruce region, yet is abundant on the island and in the white-pine region of the Lake States. Why should this island resemble the Lake States more closely than it does the neighboring country? The occurrence of jack pine on the island and adjacent mainland, but not elsewhere in New England, is another instance of this curious resemblance, the causes of which would throw light on many of the problems of ecology and forestry.

Balsam Fir.—The higher elevations, before fires swept over them, seem to have borne a forest which consisted chiefly of balsam fir (*Abies balsamea*). A remnant of this forest, containing 80 per cent fir and 20 per cent spruce, may be seen near the top of Green Mountain in a little pocket at about 1,500 feet elevation.

Spruce and Northern Hardwoods.—There is on the island a small patch of forest composed of spruce, yellow birch, beech, and sugar maple, resembling the spruce and northern hardwood association of the spruce region of northern Maine, New Hampshire, and the Adirondack Mountains. The place where this patch of forest occurs is cut off from sea winds by high hills; the same kind of forest is not found, with small exceptions, nearer than 50 miles from the coast. It would appear, therefore, that the occurrence of this association is correlated with absence of sea winds and prevalence of fluctuation in temperature.

Succession

The island of Mt. Desert, because of the rocky character of much of its surface, offers exceptional opportunities for studying succession, particularly the earlier stages. Such a study will, it is hoped, be made eventually; meanwhile the results of a few observations are given.

The first stage after the lichens consists chiefly of three-toothed cinquefoil (*Sibbaldiopsis tridentata*), different species of blueberry,

---

[6] Hawley and Hawes speak of red pine as being a comparatively rare tree in New England. "Forestry in New England," p. 41.

bearberry (*Arctostaphylos uvi-ursi*), and other members of the heath family, grasses, a little golden rod, and a few other plants. This is followed closely by ground juniper (*Juniperus communis*), pitch pine coming in with the juniper or shortly afterward. Under the pitch pine there are dense groups of huckleberry (*Gaylussacia baccata*). Reproduction of pitch pine is fairly abundant in the openings, but seedlings of white pine predominate. Mixed with the white pine are scattered seedlings of fir and a few of spruce, indicating that the stage succeeding the pitch pine will be composed chiefly of white pine with a little fir and an occasional spruce. Red pine often comes in with the pitch pine on the more favorable spots and remains in the white-pine stage. Lastly, spruce seeds in under the white pine and fir, and eventually predominates except on the dry south aspects. The final stage may, however, except on the moister sites, retain a considerable proportion of white pine. On moist flats cedar comes in soon after the pitch pine and takes possession.

EXPERIMENTS

The main experiment was designed to find the effect of soil acidity on the growth of spruce and fir seedlings. The predominance of fir reproduction under stands of spruce has always puzzled foresters and has been tentatively explained in a number of ways, but has never been studied experimentally. The most commonly accepted explanation is that the spruce renders the soil acid and unfavorable to its own reproduction, and that fir is more tolerant of acid, and hence is at an advantage in reproducing under spruce stands. If this hypothesis is correct, spruce should be more adversely affected by acid soils than fir. It might even be that fir not only tolerated, but required, acid, like blueberry, which Coville[7] found could be grown only on acid soils.

In order to determine the comparative effect of acidity on spruce and fir, seedlings of these species were transplanted from the forest into three different kinds of soil. White-pine seedlings were also transplanted, but only two were placed in the raw humus. The seedlings were of approximately the same size and were taken from the same place, so that variations due to size and vigor were eliminated.[8]

---

[7] See citation given under note 4.

[8] Nachtigall (Forstwissenschaftliches Centralblatt, pp. 55-75 and 131-150, 1916; Review in Forestry Quarterly, Vol. 14, pp. 514-517, 1916) shows that the rate of growth varies, other things being equal, with size and age. Accordingly tests were made to determine if this would affect the results in this case, and it was found that the small variation in the size and age of the plants used in this experiment was without influence.

Each soil was placed in a wooden flat approximately 8 centimeters deep, over which was placed a lath screen made so as to give half shade. All flats were kept in the open, were given no artificial watering except during the first two days to insure establishment of the plants, and were all under the same conditions except for the soil. These conditions were, furthermore, as close to natural forest conditions as possible.

Measurements made at the end of the season of similar seedlings growing in the place from which those for the experiment were taken showed that the growth on all the flats was considerably less than that in the forest, in spite of the heavier shade in the forest. This is probably due to two causes: first, the bottom of the flats prevented the ascent of capillary water, rendering moisture conditions less favorable than in the forest; second, the disturbance of the roots caused by transplanting would tend to make the growth of the transplants less than that of the seedlings growing undisturbed in the forest.

Soils

The three soils were:

(1) A thoroughly decomposed forest humus which had been taken from the forest and rotted in a field for two years.

(2) Undecomposed raw humus, taken directly from the spruce association, and consisting of needles, cone scales, and other forest litter. This is Coville's "upland peat," the forest "duff" which accumulates in northern regions because decomposition is retarded by lack of sufficient warmth.

(3) Mineral soil from beneath the raw humus. This is a reddish brown bouldery glacial till in which the rocks and boulders comprise about 50 per cent or more of the volume. For the experiment only the soil in between the rocks, from which all but scattering small pebbles had been removed by hand, was used.

Physical Properties of Soils

Physical properties of soils are best given in terms of the physical constant which bears the closest relation to plants. The wilting coefficient, though perhaps not strictly a physical constant,[9] gives the best idea of the physical properties. Unfortunately direct determinations were impossible, except on the decomposed humus, because neither wheat nor corn would produce sufficient root systems on these soils. On the decomposed humus a single direct determination gave a wilting

---

[9] Free, E. E.: "Studies in soil physics." Plant World, Vol. 14, pp. 29-39, 59-66, 110-119, 164-176, 186-190, 1911.

coefficient of 12 per cent on the basis of air-dry weight. Calculations from the moisture-holding capacity at saturation, which are probably unreliable for these soils, gave, on the basis of volume, wilting coefficients of 21 per cent for the decomposed humus, 15 per cent for the raw humus, and 12 per cent for the mineral soil.[10] The most reliable physical property which could be determined with the apparatus at hand is the moisture-holding capacity, saturated.[11] The mild humus had a moisture-holding capacity, saturated, of 138.5 per cent of its air-dry weight, or 82.6 per cent of its volume. It absorbed water rather rapidly. The raw humus, on the other hand, took up water with extreme slowness, the cylinder, only a centimenter thick, requiring 48 hours or more to become saturated. The capacity of this soil is 504.6 per cent of its air-dry weight, but only 65.1 per cent of its volume. The high percentage of water on the basis of weight gives an idea of the extreme lightness of this raw humus. The mineral soil takes up water with great rapidity and holds, when saturated, 66.8 per cent of its air-dry weight and 56.9 per cent of its volume. This soil looks rather clayey and sticky when wet, but leaves practically nothing in suspension in water after an hour and a half.

Chemical Properties of Soils

The only chemical property determined in this investigation was the acidity. The determinations were made in such a way as to secure quantitative results comparable with those of other workers. Two methods of testing acidity were employed: First, the method given by Coville in his "Experiments in Blueberry Culture" (pp. 26-28);[12] and, second, the new Truog method.[13] The results should be comparable with those of other workers using either of these methods. But the methods are not comparable with each other. The method used by Coville measures the acid which can be extracted by a given quantity of hot distilled water, expressing the results in decimals of normal acidity. Ten grams of soil are shaken up with 200 cc. of hot distilled water and left to stand over night. A measured quantity of the filtered extract, boiled to drive off the CO_2, is then titrated with an .05 normal solution

[10] Briggs, L. J., and Shantz, H. L.: "The wilting coefficient for plants and its indirect determination." U. S. Dept. Agr., Bureau of Plant Industry, Bull. 230, 1912, pp. 66-68. Hilgard's method of determining the moisture-holding capacity at saturation calls for using volume instead of weight, but the Briggs and Shantz formula is based on dry weight. See Hilgard, E. W.: "Soils." New York, 1912, p. 209.

[11] Hilgard, E. W.: "Soils." New York, 1912, p. 209.

[12] See note 4 for citation.

[13] Truog, E.: "A new test for soil acidity." Agr. Expt. Sta. Univ. Wis. Bull. 249, 1915.

of sodium hydroxide, using phenolphtalein as an indicator. The quantity of the alkali required to neutralize the soil extract gives, when reduced to the basis of normal alkali per cubic centimeter of extract, the acidity of the soil in terms of a normal solution.

The decomposed humus was found by this method (and also by the Truog method) to be neutral; the raw humus showed an acidity of .002 normal and the mineral soil an acidity of .00017 normal. These acidities are weak when compared with those which Coville found in soils favorable to blueberry growth.

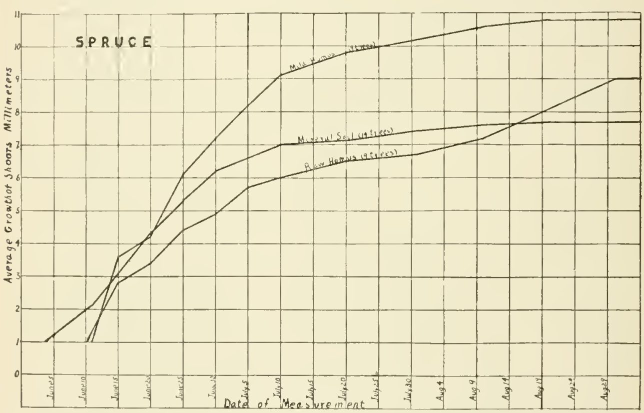


FIG. 1.—Influence of soil on the growth of red spruce (*Picea rubens*). Mild humus was neutral; the raw humus had an acidity of .002 normal by the Coville method, and was strongly acid by the Truog method; the mineral soil had an acidity of .00017 normal by the Coville method, and medium acidity by the Truog method. Number of trees on which averages were based are given on each graph.

The Truog method measures the hydrogen sulphide liberated by the soil acid when the acid combines with zinc in a solution of zinc sulphide. Calcium chloride is added to the solution to make the test more sensitive. The quantity of hydrogen sulphide is determined approximately by the darkening of lead acetate paper placed over the mouth of the flask in which the soil is boiled with the zinc sulphide and calcium chloride. Different colors in the lead-acetate paper express different degrees of acidity, according to a standard color chart. Five shades are used, representing very slight, medium, strong, and very strong acidity, the very slight being a faint yellow and the very strong nearly black. The test possesses the advantage of simplicity and ra-

pidity of manipulation and is made with a specially devised apparatus which is inexpensive and can readily be carried into the field.[14]

By the Truog method the decomposed humus was found to be neutral, the raw humus strongly acid, and the mineral soil of medium acidity.

Tests at the end of the season to determine the extent to which ex-

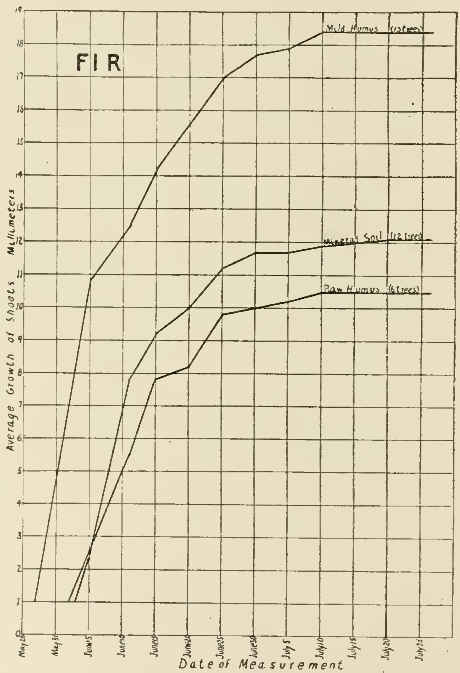


FIG. 2.—Influence of soil on the growth of balsam fir (*Abies balsamea*). See figure 1 for acidities

posure had diminished acidity showed that during the period of the experiment the diminution was negligible.

Results

Coniferous Transplants.—The measurements showed that the growth of both fir and spruce was most rapid on the mild humus, effectually

[14] Apparatus can be secured from the Central Scientific Co., Chicago, for $5.

disposing of the theory that acidity is required by fir. The difference in rate between the neutral and acid cultures was greater in fir than in spruce, indicating that, contrary to the common conception, spruce withstands acid better than fir. Growth of both fir and spruce on the mineral soil was slightly more rapid than on the raw humus, except that toward the end of the season some of the spruces on the raw humus began a second period of elongation which enabled them to pass those on the mineral soil. Figure 1 shows graphically the growth of spruce on each of the three soils and figure 2 shows the same for fir.

The second period of elongation in spruce is a curious phenomenon which, when better understood, may throw some light on the response of the tree to the various influences surrounding it. Growth in length became slow by July 10, and by August 10 the winter buds began to form, indicating cessation of growth in length for the season. But by August 20, after a rather warm ten days without rain, some of these newly formed buds burst open and started to grow just as at the beginning of the season. That soil as well as climate plays a part in this phenomenon is indicated by the percentage of trees affected on the different soils. On the raw humus 38 per cent started a second growth period; on the mild humus 11 per cent, and on the mineral soil only 9 per cent.

A similar second growth period has been noticed by Nachtigall[15] in 4-year-old Norway spruce in Germany in the course of an experiment similar to the one here described, except that the measurements were made on trees in the forest. Curiously enough, the beginnings of growth, the period of maximum rate, and the cessation of growth in Germany closely parallel that on Mt. Desert Island, only being about 15 days later on Mt. Desert Island.

The duration of the period of growth in length for the different species is the reverse of what we would expect from the rate of growth shown by stem analyses. The fir buds opened on June 1 and stopped elongating on July 10, 40 days later; spruce and white pine began on June 5 and did not stop till August 20, a period of 75 days, or nearly twice as long as that of fir. Yet the fir is a faster-growing tree than spruce. The explanation may be that the fir gets its new needles more quickly than spruce and then continues its diameter growth for the rest of the season. Unquestionably, diameter growth continues long after height growth has stopped. The shorter period of fir is probably correlated with the more northerly range of this tree as compared with spruce.

[15] See note 8 for citation.

The roots of the transplants in the flats showed at the end of the growing season some remarkable effects of soil differences. The most striking effect was upon the period of root growth. At the end of October, more than two months after the growth of the shoots had ceased, the roots of all three species—spruce, fir, and white pine—were still functioning on the raw humus. This was shown by the abundance of small, translucent growing tips characteristic of roots at the height of the growing season. These growing tips were absent on the mild humus and mineral soil, except for the fir rootlets on the mild humus in contact with the wood of the flat. This exception seems to indicate that the wood of the flat had the same effect in favoring continued absorption as the forest litter composing the raw humus. Further evidence of the value of organic material just beginning to break down is seen in the propensity of both spruce and fir rootlets for growing through cones and twigs. The indications are that spruce and fir on their natural soils, the raw humus of the forest, maintain the power of root absorption for a large part of the year, if not for the entire year, in such a way that they are able to take advantage of brief intervals of warmth to absorb water. This is in accordance with the researches of Resa,[16] who found that a root growth in conifers persisted through the year except for a rest period in January and February, and of Peterson,[16] who found that root elongation in *Picea excelsa, Pinus montana,* and *Larix decidua* may begin in February and continue to November. Gates[17] found that the ericads are capable of conducting moisture with a temperature as low as 15° C.

The different soils also brought about differences in the character of the roots. The spruce roots in the raw humus resembled those growing under natural conditions in the forest, having the characteristic brown color and dense branching, while those of the same species in the mild humus were black, were considerably less in diameter, were not quite as much branched, and had a large proportion covered with a white fungus mycelium. The mineral soil had the poorest spruce roots, much less branched than those on the raw humus or mild humus and with less growth in length; consequently with much smaller root area. Many of the root tips were covered with a white mycelium which appeared to be the same as that found in the mild humus. The thickness of the roots was intermediate between those of the raw humus and mild humus.

---

[16] Quoted by Brown, H. P., in "Growth studies in forest trees." Bot. Gaz., Vol. 59, No. 3, pp. 193-241, 1915.

[17] Gates, F. C.: "Winter as a factor in the zerophily of certain evergreen ericads." Bot. Gaz., 57, pp. 445-489, 1914.

The fir roots responded to soil differences in the same way as spruce, except for branching. In fir there was somewhat more branching on the mild humus than on the raw humus. In fact, one of the chief characteristics of fir on the raw humus was the length of new root growth without branching. This agrees with the natural habit of the tree. Fir roots in the forest are always much less branched than those of spruce, a character of importance in competition when the two trees grow on the same site, and also accounting to a certain extent for the frequent occurrence of each on different habitats. For example, the branching superficial habit of spruce confines the tree to sites with abundant surface moisture and lays it open to danger from windfall. Fir, on the other hand, appears to be able to grow on somewhat drier sites and on the mountain tops exposed to severe winds. There are, of course, other characteristics which play an equal, if not greater, part than the roots in these habitat differences.

The fir roots on the mineral soil were not only less thrifty than on the mild humus and raw humus, but were in some cases badly infested with a black fungus which is common on spruce, fir, and white pine in the forest. There was but little of this fungus on the other two soils. This, with the fact that in the forest the fungus attacks some roots and not others on the same plant, would indicate that the occurrence of the fungus is correlated with low root vigor rather than with abundance of fungus spores; for the spores must have been even more abundant in the raw humus than in the mineral soil.

In order to secure a rough numerical idea of the differences between the root development of the same species on the different soils, measurements were made of the season's root growth on the main root and on from one to three branch roots of a few plants taken at random from each flat. The averages of these measurements are given in Table 1.

TABLE 1.—*Influence of soil on the length of root growth in spruce and fir*

	Acidity		Length of average root growth for the season in millimeters		
	Coville method	Truog method	Spruce	Fir	White pine
Mild humus............	neutral	neutral	76	106	90
Raw humus [a]...........	.002	strong	60	88	note
Mineral soil............	.00017	medium	30	39	74

[a] Raw humus had only two white-pine transplants, averaging 131 millimeters.

Since the root measurements were made at the end of October, while the measurements of the tops were concluded when the growth in length ceased (July 10 for fir and August 10 for spruce and white pine), it is not to be expected that there should be complete agreement between the

two sets of measurements. In the top measurements (figs. 1 and 2) the mineral soil showed a little more rapid growth than the raw humus, while in the root measurements the mineral soil falls far behind the raw humus. The most probable explanation is that the plants on the mineral soil were injured by a hot, dry period of 16 days in the middle of August. The soil of the flats, being only 8 centimeters deep and cut off from capillary water, was subject to rapid drying out in spite of the

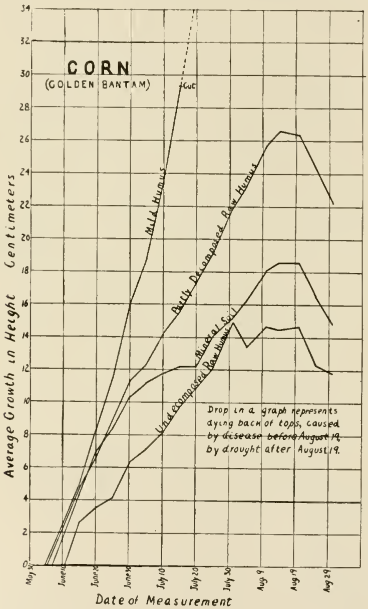


FIG. 3.—Influence of soil on the growth of corn. See figure 1 for acidities.

covering of half shade. Under these conditions the mineral soil, having the lowest moisture-holding capacity, dried out more rapidly than the other soils. Another factor which may also partly explain the inferior root development in the mineral soil is the poorer aëration of this soil. Since the mineral soil, though decidedly less aërated than the mild humus and raw humus, was not a heavy soil, we have another indication of the need for ample soil oxygen on the part of conifers.[18]

---

[18] Boerker, R. H.: "Ecological investigations upon germination and early growth of forest trees." Univ. of Nebraska, Jan., 1916.

Crop Plants.—Several of the commoner crop plants were tried on the same soils, for the physical factors controlling tree growth apply to herbs as well as to trees. In addition to the three soils above described, a fourth, a partly decomposed humus from a small opening in the forest, was used in these experiments. This soil showed an acidity of .0013

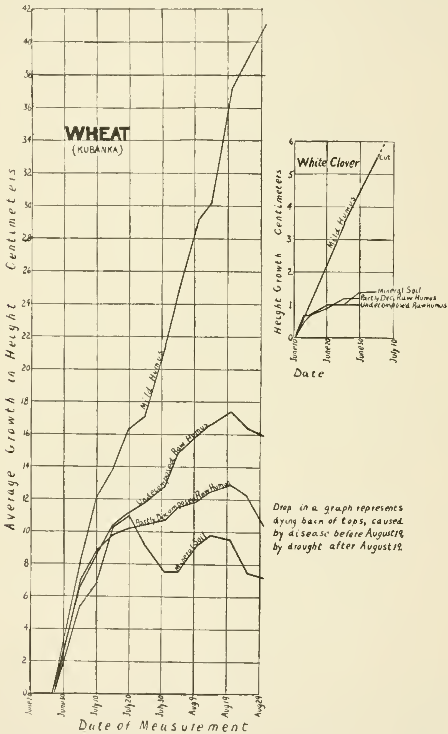


FIG. 4.—Influence of soil on the growth of wheat and clover. See figure 1 for acidities.

normal by the Coville method, or approximately half as much acidity as the undecomposed humus, though by the Truog test it was more strongly acid than the undecomposed humus. The physical properties of this soil appeared to be similar to those of the undecomposed humus, the moisture-holding capacity at saturation being 451 per cent of the air-dry weight, or 65 per cent of the air-dry volume.

The growth of corn, wheat, and clover, measured at five-day intervals, is shown graphically in figures 3 and 4. The plants were growing on the same flats as the coniferous transplants, and consequently were under half shade until they reached about 15 centimeters in height.

These graphs show that the mild humus was by far the most favorable for all plants concerned; in fact, the corn grew so well on this soil that it had to be cut by the 15th of July to prevent interference with the rest of the experiment. But aside from the favorableness of the neutral humus, growth does not appear to be directly correlated with acidity except in the case of clover. For example: With corn, the mineral soil, though considerably less acid, shows up more poorly than the partly decomposed humus; and with wheat the mineral soil, though least acid, is the poorest of all. The poorness of the mineral soil for these plants may be due to the lack of organic matter and the unavailability of its mineral nutrients, its "rawness." If this is the case, the availability of nitrogen seems to be the important factor for these plants, although the use of the nitrogen, where it is available, is limited by the presence of acids.

The effect of acidity upon growth appears to be more marked in clover than in the others. On all three acid soils it gradually died and disappeared, but persisted longest on the mineral soil.

The following table gives the dry weight per plant of the wheat and corn grown on the different soils, except for the corn on the mild humus. The figures give a quantitative idea of the crop-producing possibilities of these soils.

TABLE 2

	Dry weight per plant, cut September 15, 1916 — Grams	
	Corn	Wheat
Mild humus	Cut July 15	.53
Mineral soil	.13	.03
Partly decomposed humus	.49	.03
Undecomposed humus	.09	.08

The corn and wheat afforded an opportunity of observing the effect of soil upon drought resistance. Ordinarily we would expect the influence of drought to be directly related to the physical properties of the soils affected. In this case, however, the effects of drought and recovery from drought were correlated with soil fertility. The controlling factor here was the vigor of the plants, which in turn was determined by the fertility of the soil. Thus in both corn and wheat the smallest percentages affected by the drought were on the mild humus;

in fact, both drought resistance and drought recovery are in the same order as the rate of growth shown in the graphs, figures 3 and 4.

Germination and Damping-off.—A preliminary experiment on the relation of moisture to germination in raw humus throws an interesting light on the effect of dryness upon the rate of germination and upon damp-off; for undecomposed raw humus is not the universally moist substratum it is commonly supposed to be. In spite of its high moisture-holding capacity, it is very porous and dries out rather rapidly. Hence dryness is an important factor in reproduction, even in humid regions.

Red-pine seed was sown in pots containing raw humus of different degrees of moisture. Pot 1 was watered daily; pots 2 and 3 received only rain water, which at the time of the experiment was not abundant except for the first 18 days after sowing. Since the pots received full sunlight for about three to four hours every day (as in many medium-sized openings in the forest), the unwatered pots became rather dry after only one or two days without rain. Pot 3 was drier than pot 2 because, instead of containing solid raw humus, it had only 3 to 4 centimeters of raw humus underdrained with 8 centimeters of rocky soil. The effect of moisture upon the rate of germination was striking. In the moist humus germination was rapid and uniform, 66 per cent coming up within 5 days after the first appearance, while in the drier pots germination was slow and straggling, 31 per cent coming up on pot 2 and only 11 per cent on pot 3 in five days after the first appearance. The seedlings in the moist humus were noticeably thriftier than in the drier humus.

The most unexpected result was the effect of dryness upon damping-off. On nursery soils excessive moisture has generally increased the damage from damping-off, while sunlight and dryness have been considered as preventives. In this case moisture prevented damping-off, while dryness markedly increased it. On the moist humus the loss from damping-off was nil; on pot 2 the loss was 38 per cent and on pot 3 it was 40 per cent of the number germinating. The explanation is probably to be found in the great abundance of fungus spores in raw humus and in the much greater vigor and power of resistance on the part of the seedlings in the moist humus. It is also possible that the high degree of moisture maintained a certain amount of acid continually in solution in the humus, and that this acid retarded or prevented the germination of the damping-off spores without affecting the seedlings. It is well known that acid tends to prevent damping-off, and that one of the most effective methods of combating the disease is treatment

with sulphuric acid followed by constant watering during the period of germination.[19]

OBSERVATIONS

Root Systems

Field observations on the root systems of spruce, fir, and white pine showed that detailed studies of roots would probably yield interesting results. Spruce roots form a dense mat in the raw humus, or "duff"—a mat so dense that hardly a square centimeter under a spruce stand escapes. The rootlets keep growing toward the surface as the humus deepens, those in the lower layers dying back. Hence spruce is in a position to get the first water that reaches the forest floor. The quantity absorbed by these roots must be enormous and cannot fail to be an important factor in reproduction.

Fir roots are characteristically much less branched than those of spruce and seem to go more into the mineral soil, though they also feed largely in the "duff." This greater penetration may possibly explain in part the ability of fir to grow on drier sites than spruce. White pine absorbs from both the raw humus and the mineral soil.

The roots of all three species are often affected by a fungus which produces black threads of mycelium on the root tips. These threads prevent absorption and kill the portion of the root attacked; yet seedlings appear thrifty even when a large proportion of their roots are affected in this way. Perhaps, since the fungus attacks only the smaller rootlets, the plant is able to develop new rootlets about as fast as the affected ones die off.

Interception of Precipitation by Spruce Crowns

A factor of more importance than hitherto recognized is dryness due to the interception of precipitation by the crowns of spruce. The lack of vegetation under a forest of spruce has generally been attributed to lack of light. While light plays an important part, there are probably many cases where lack of moisture rather than lack of light is the determining factor. A rather striking illustration may be cited. Under the crown of a spruce growing in the open was found a patch of forest floor similar in every respect to the forest floor found under dense stands of spruce. Herbaceous vegetation and tree reproduction stopped abruptly at the edge of this spot, yet the crown of this tree was high enough to allow the ground under it to receive ample light. The only vegetation under the crown was a few grasses and asters, light-demand-

[19] Hartley, Carl: "The control of damping-off of coniferous seedlings." U. S. Dept. Agriculture Bull. 453, 1917.

ing but comparatively drought-resistant plants. The bareness of this piece of forest floor was due to lack of moisture, not to lack of light. This was confirmed by moisture tests, which showed that the soil beyond the crown—soil which had been giving up moisture to a thick herbaceous cover all summer and should consequently be drier than a spot which had given up nothing to vegetation and was not subject to high evaporation—possessed 59 per cent of moisture on the basis of air-dry weight as against 20.5 per cent under the crown of the spruce. On the basis of volume, which gives a better conception of the moisture relations in these light soils, the soil in the open contained 19 per cent of moisture, as compared with 5.7 per cent under the crown. In another case, in a spruce forest the moisture under a small opening in the canopy was 20.9 per cent by volume, as compared with 7.3 per cent under a spruce crown. In both of these cases the soil under the crown was powder-dry to the touch, while that beyond the crowns felt moist. It is evident, then, that under the crowns of spruce the soil is often so dry that neither reproduction nor herbaceous vegetation can become established, no matter how much light it receives.

Reproduction

Counts of the reproduction of spruce, fir, white pine, and cedar, correlated with age, showed that spruce, fir, and white pine become established only at intervals of several years, while cedar comes in every year. The cause of the failure of spruce and fir to become established every year is apparently not related directly to climatic factors, because the season of 1916 was unusually moist and favorable, yet practically no seedlings of these two species could be found. Probably, then, the reason for this periodicity in spruce and fir reproduction is to be sought largely in the seed supply. White pine reproduced abundantly in 1916, so that climate cannot be eliminated as a factor; but since it is equally impossible to eliminate the matter of seed production, the periodicity of white-pine reproduction may be due to both the season and the seed supply.

In fir there are indications of a periodicity of reproduction which is of considerably more importance than that due to the seed supply. Under many spruce stands which have reached about middle age the fir reproduction is nearly all composed of large seedlings from approximately one to three feet in height; young seedlings are scarce. In these cases it appears that the fir came in profusely under a set of environmental conditions different from the present ones. Just what these conditions were it is impossible to say without further study. One of

them may have been stronger light than at present. Indications of this were found in the fact that some of these cases of fir reproduction occur in stands which were formerly more open than they now are; also, small fir reproduction is abundant in young stands with a full but not very heavy canopy. That light is a factor would be in accordance with Zon's conclusion.[20] Another factor may be decreasing moisture, due to the interception of precipitation by the crowns of the spruce trees, and to a fuller use of the humous water by the increasing mat of spruce roots. Whatever the factors are, it seems evident that fir reproduces within a more or less sharply marked range of environmental conditions.

Each species reproduces only within a certain range of factors. This range is probably a specific characteristic of each tree, possibly of each plant, and appears to be different even for trees growing together in the same association.[21] Determination of this range for even a few of our more important trees would be a valuable contribution to science.

[20] Zon, R.: "Balsam fir." U. S. Dept. Agr. Bull. 55, 1914.

[21] Shreve, Forrest: "The vegetation of a desert mountain range as conditioned by climatic factors." Carnegie Inst. of Washington, Publ. 217, 1915. Has recently shown that different plants growing together in the same association have different life requirements.

UTILIZATION AND REFORESTING OF CHESTNUT-BLIGHTED LANDS

By Leonard C. Barnes

Forester, Nittany Forest, State of Pennsylvania

It is now a clearly established fact that the chestnut-tree bark disease has obtained a firm hold in the chestnut stands in the eastern part of the United States, and that its progress is an uninterrupted advance throughout these stands. No successful method of combating the disease has been discovered, and it appears that ultimately it will exterminate the chestnut trees. The only practical method of arresting its advance has been to cut and utilize the chestnut in affected areas. The following proposes to show this method in actual operation.

In the spring of 1912 the chestnut-tree bark disease was discovered upon the Nittany State Forest. At that time the blight was restricted to a few trees on an area of less than five acres. The usual methods then in vogue were put into practice—that is, infected trees were immediately cut and barked, the stumps peeled, and the bark of the entire tree, together with the limbs and small branches, piled over the stump, and the whole mass burned. It was thought that the disease in the Forest would thus be checked; but in the spring of 1914 the disease had spread to such an extent that it covered an area of more than 25 acres, and in 1915 the entire stand was more or less attacked. An examination of the stumps of trees cut four years ago showed that nearly every chestnut sprout was blighted, and of the remaining standing trees 3 per cent were killed and 75 per cent diseased. Such a condition made it necessary to cut over the entire stand. The trees that were not already killed would soon die, and prompt measures were required in order to utilize the already dead material before insects attacked it and decay set in. A plan was accordingly devised calling for a clear cutting of the area, piling and burning the brush, and reforesting with coniferous species. This plan fitted in nicely with a lumbering operation that was then being conducted upon the Forest.

The blighted area is located at the extreme western end of the Nittany State Forest, in Center County, Pennsylvania, two miles distant from the town of Pleasant Gap, is 120 acres in size and situated on the south slope of a gap in the Nittany Mountain at an elevation of 1,200

feet. The soil to a depth of 8 inches is a fine loam, ranging in texture from silty to sandy, and varying in color from brownish-red to reddish-brown. The subsoil is a sandy loam, grading with depth into a clay loam. The soil is relatively moist and the drainage good. The average rainfall is 36 inches. The average temperature for the year is 54° F.

The stand before cutting was composed of chestnut, chestnut oak, white oak, and red oak, averaging 408 trees to the acre, of which chestnut formed 60 per cent and chestnut oak 20 per cent. The area had been cut over 35 years ago to supply "coal wood" for the iron furnaces operating in the valley at that time; consequently it was of even age. The trees were fairly uniform in size, averaging 6.9 inches d. b. h. and 58 feet high for chestnut, and 6.3 inches d. b. h. and 53 feet high for chestnut oak.

The work of cutting the tract was let under contract, the Department of Forestry receiving a specified stumpage price for each product. This contract was under the supervision of the forester in charge, who received each month a sworn statement of the amount of material removed. Check statements were also received from the companies to whom the products were shipped. The contract called for the removal of all merchantable trees of all species within a specified time, the working of the material into products having the highest stumpage value, the making of fence posts from trees not infected with the blight, the cutting of all brush and small inferior trees which could not be used, and the piling of these, together with the brush from lumbering, into suitable piles for burning in the spring. The reason for clean-cutting the area was twofold: First, to make the operation a paying one; second, the oaks, although good species and producing valuable timber, have a slow rate of growth, and it was thought better to replace them with faster-growing species.

In the beginning of the operation four cordwood cutters were employed, who cut and worked the trees up independently of each other. They were paid at the rate of 60 cents per cord and averaged two cords a day per man. Later a gasoline wood-saw was installed. Under this method the trees were cut, trimmed, and skidded to the saw and there cut into four-foot lengths. The average cut per day was increased to five cords per man and the cost lowered to 40 cents per cord. From the larger-size trees sawlogs, railroad ties, and telephone poles were cut out first and the tops worked into cordwood. Where chestnut was used, the bark was peeled before the material was removed.

The hauling was done under contract, at $1.25 per cord. The haul

was all down grade, by wagon, over a poor road for the first mile. Teams usually loaded 1.75 cords, and made two trips a day to the railroad siding, three miles distant. Sawlogs, railroad ties, and telephone poles were banked along the road, and the principal contractor was obliged to remove them at his expense. Fence posts were sold in the woods.

No difficulty was experienced in the disposal of the products. Owing to the small size of the trees, the majority of the product was four-foot wood. Extract companies and lime-kilns were the principal outlet for this material, which was shipped to them at prices varying from $2.50 to $4, f. o. b. Pleasant Gap, per cord of 128 cubic feet.

In order to furnish a clear idea of the cost of the operation and the profits to the Department of Forestry and the contractor, the table on the following page has been prepared.

In April, 1917, the area then cut over was burned. The tract was surrounded on all sides by well-traveled wagon roads which afford excellent lines of control. The day selected for burning was somewhat cloudy and still. A force of ten men was placed along the roads to guard against the fire crossing into the wooded area. The burning was started at the top of the ridge and on the east side, so that it would travel down hill and towards the direction of the prevailing winds. A complete burn was not obtained by this method, and a few days later, under more favorable weather conditions, each pile was fired separately. The entire area was thus completely cleaned of all brush and debris at a total cost of $35.86, or $1.02 per acre. (Only 35 acres were cut and burned.) The tract was then ready for planting.

In the past the general policy of reforesting on the Nittany Forest had been towards pure plantations of white pine; but as an experiment, and taking into consideration the site and the silvicultural requirements of the various species, it was decided to use white pine and Scotch pine mixed in alternating rows.

The seedlings used were 35,000 three-year-old white pines, costing $2.00 per thousand, and 22,000 two-year-old Scotch pines, costing $1.50 per thousand, raised in the State Nursey at Mont Alto.

The planting was done by a crew of sixteen, composed of six mattock men, six planters, one seedling carrier, one water boy, one extra planter, and a forest ranger. The purpose of the extra planter was to help any planter who was falling behind his mattock man. The trees were spaced 5 feet by 5 feet, disregarding the presence of stumps and sprouts. The burning of the brush completely destroyed the sprouting capacity of a large number of stumps, and the chestnut blight will in all

TABLE 1.—*Values*

Product	Amount	Cost of producing		State stumpage		Market value		Contractor's profit	
		Per unit	Total	Per unit	Total	Per unit	Total	Per unit	Total
Acid wood............	317 cords	$1.98	$629.85	$0.25	$79.25	$3.00–4.00	$1,211.99	$1.58	$502.89
Kiln wood............	290 "	1.85	536.50	.12½	36.25	2.50	725.00	.52½	152.25
Fence posts...........	2,456 pieces	.02	49.14	.01½	36.84	.10	245.60	.06½	159.64
Railroad ties..........	350 "	.28	98.00	.08–.18	39.12	.30–.80	210.55	.21	73.43
Telephone poles........	202 "	.58	118.37	.40–1.00	100.65	1.75–4.50	425.25	1.02	206.23
Lumber	1,200 bd. ft.	9.00	10.80	3.00	3.60	22.00	26.40	10.00	12.00
Total............	....	......	$1,442.66	......	$295.71	......	$2,844.79	......	$1,106.44

NOTE.—Cost of producing includes hauling and loading costs.

probability kill, in a few years, any chestnut sprouts that may come up. Other hardwood species that sprout and threaten to interfere with the growth of the pines will be cut back and in a few years the rapid growth of the planted trees will place them beyond all danger of suppression. Following is the cost of the planting operation:

		Per acre
Total cost of seedlings	$105.50	$3.01
Total cost of transportation	10.25	.29
Total cost of labor planting	111.60	3.19
Total cost of supervision	27.70	.79
Total cost of the plantation	255.05	7.29

The tract cut over to date amounts to 35 acres. It is a part of a purchase made in May, 1902, by the State of Pennsylvania to form a State Forest. The purchase price paid was $2.50 per acre. Taxes upon the land amount to 4 cents per acre per year, and administration, protection, and other charges amount to 10 cents per acre per year. These sums, at 2 per cent compound interest, the rate Pennsylvania pays for borrowed money, amount in 15 years to $2.10 per acre.' In summarizing the cost of clearing the land and replanting, we have

	Per acre
Interest on land and annual charges for 15 years (from date of purchase)	$2.10
Cost of burning brush	1.02
Cost of plants and planting	7.29
Total expenses	10.41
Total receipts (State stumpage)	8.45

So the actual cost of replacing this diseased and damaged stand with thrifty young seedlings that promise well to produce a more valuable yield is $1.96 per acre. If the timber and land had belonged to an individual he would have had a net profit of $21.19 per acre over and above the cost of lumbering and planting.

A PRACTICAL XYLOMETER

By J. S. Illick

Acting Director, Pennsylvania State Forest Academy

Practical and precise instruments are an essential feature of any good business. They are especially serviceable during the formative period of a business, when efforts are directed primarily towards building up a body of exact knowledge which, as a rule, is a potent determinant factor of future development. The present need of such a body of exact knowledge is nowhere greater and more urgent than in the practice of American forestry. In order to satisfy this impending want, a comprehensive series of systematic forest investigations should be instituted at once, for it is only by this means that a durable foundation of rational forest development can be laid. Such a procedure requires not only able investigators, but also a full equipment of modern scientific appliances.

A practical xylometer is an indispensable part of the equipment of a forest investigator working upon problems requiring an accurate determination of volume. The limited use of xylometers in the past may be largely attributed to their impractical construction and the consequent difficulty of loading and unloading them. During the past five years the writer has been using a xylometer which, on account of its practicability, deserves a more extensive use. It has given satisfaction in tree analysis work and in growth and yield studies, particularly in determining the contents of mean sample trees in second-growth stands, and it has been especially serviceable in determining the waste factor of portable sawmills, shingle mills, lathe mills, and logging operations.

The principle of operation is alike in all xylometers. It is based upon the fact that a submerged body displaces a volume of water equal to its own solid contents. The method of ascertaining the volume varies with the type of instrument used. Two types are generally recognized, viz., graduated and ungraduated. Graduated xylometers are only partly filled with water, whose position before and after submersion is noted, and the difference represents the volume of the submerged wood material. On the other hand, ungraduated xylometers are completely filled up with water to an opening or overflow, then the wood material is submerged, and the displaced volume of water escaping

Loading the Xylometer with Lath

If only two men comprise the operating crew it is, as a rule, advisable to plug up the overflow spout during the loading of a charge

The Xylometer in Operation

Some water is displaced by the weight of the wood. Towards the end of the operation pressure must be applied to the wood in order to submerge it completely. The displaced water must be collected in a container. Its volume may be determined by measuring or weighing it.

through the opening or overflow represents the exact volume of the submerged material. Either type gives satisfactory results; only the former may be operated somewhat more economically.

The xylometer shown in the accompanying illustration is of the ungraduated type, and was improvised from an ordinary round-end galvanized steel storage tank by simply removing several unnecessary top cross-braces and attaching a spout near the top of one end for the purpose of affording an overflow for the displaced water. These tanks are easily procured, for they are carried in stock by most firms dealing in farm and orchard equipment, and the alterations required to convert them into xylometers are inexpensive and easily made by any amateur mechanic. Furthermore, this instrument has a number of other good features, namely, cheapness, practicability, portability, and accuracy.

The cost is determined primarily by the desired size and the gauge of the galvanized steel sheeting. A tank constructed of number 20 gauge galvanized steel sheeting, 7 feet in length, 2 feet high, and 2½ feet wide, with a capacity of 245 gallons and a weight of 141 pounds, retails at about $12.80. The stock sizes usually range from 4 to 10 feet in length and from 2 to 4 feet in width, with a standard height of 2 feet. Small tanks suitable for shingle and lathe mill studies retail for about $6, and extra large sizes for about $20.

Ease of operation is the chief distinguishing feature of this form of a xylometer. It is a real practical instrument in contradistinction to the round vertical type of the past, which was rarely used on account of its impracticability. The horizontal position of the new instrument facilitates the loading and unloading of the wood, and its added length permits the measurement of long sections of trees. These decisive advantages have extended the range of application of the instrument and reduced the cost of operation considerably. A crew of two men is sufficient to operate it. The rapidity with which the water can be replaced after each charge is the chief determining factor of the amount of wood which a crew can measure per day. It is very important that the xylometer should be located near an adequate supply of water, or else the displaced water of one charge should be conserved for subsequent charges. In woods operations the tank may be refilled from a stream by conveying the water through a triangular trough, while in mill operations the water may be obtained from the pipe feeding the boiler. In a 10-hour day a crew of two men should determine the volume of 25 to 40 trees ranging in breast-high diameter from 6 to 18 inches, providing an adequate supply of water is constantly at hand.

Another commendable feature of this new type of xylometer is its portability. A tank 8 feet long, 2½ feet wide, and 2 feet high weighs only about 140 pounds. The ease with which such an instrument may be transported, because of its light weight and practical form, is a distinct advantage when the work is done in the forest. In many cases it is easier and more economical to transport the xylometer than the wood material.

The degree of accuracy which may be attained by using a xylometer recommends this instrument for most scientific investigations requiring an accurate determination of volume. The exclusive use of a xylometer is not always recommendable. In many cases it may be satisfactory to use it only intermittently as a check on other less accurate but more practical methods. The following tabulation gives the results obtained by three different methods of computing the contents of seven representative trees selected from a large number comprised in a tree analysis study:

Tree number	Schiffel's formula *cubic feet*	Smalian's[1] formula *cubic feet*	Xylometer[2] *cubic feet*	Xylometer[3] *cubic feet*
1	24.70	23.85	24.78	25.05
2	53.53	55.18	56.95	73.72
3	47.70	48.53	50.70	60.50
4	16.93	17.07	17.70	21.22
5	67.73	81.97	94.91	112.26
6	10.22	11.68	11.49	14.56
7	36.72	37.50	38.12	40.90

A comparison of the above results shows that the volume obtained by Schiffel's formula is only 87 per cent and that of Smalian's formula only 93.5 per cent of that ascertained by the use of the xylometer in determining the volume of the stem only. A further comparison of columns four and five shows that the branches comprise on an average 18.8 per cent of the total tree volume, ranging from 1.1 per cent in tree number one, which was a suppressed white pine with a very small crown, to 22.8 per cent in tree number two, which was a dominant white pine with high and wide crown.

Tree number one—a white pine—was manufactured into shingles. It yielded 603 shingles (4 x 21 inches), which displaced 11.86 cubic feet of water, showing that only 47.3 per cent of the wood originally in the tree remained in the finished product. Tree number seven—a chestnut—was also manufactured into shingles. It produced 908 shingles (4 x 21 inches), which displaced 18.97 cubic feet of water, indi-

[1] Stem only. Sections 4 feet in length.
[2] Stem only.
[3] Stem and branches.

cating a waste of 53.6 per cent of the original contents during the process of manufacture. Such figures would be almost incredible if they were not demonstrable and the result of a careful study with an accurate instrument.

There has always been a large amount of waste incident to the manufacture of a tree into lumber and other products. This enormous leak went on unnoticed so long as wood was plentiful, but now that the supply is becoming more limited, attempts are being made to close up the leak by developing a closer utilization of all forest products. The first logical step in the reduction of this enormous wood waste is an accurate determination of the amount of waste and a careful study of the processes of manufacture and remanufacture. The xylometer affords the most practical and accurate means of determining the percentage of waste, and may be of inestimable value to the forest operator bent upon a closer utilization of forest products.

A SIMPLIFIED METHOD OF STEM ANALYSIS[1]

By T. W. Dwight

Assistant Director of Forestry, Department of the Interior, Canada

From the standpoint of work involved, there lies a broad gap between the ordinary methods of volume table work and "complete stem analysis," greater than seems to be entirely justified by the difference in the quantity of information secured in the two cases. A volume table gives no data in regard to growth. The recognized methods of stem analysis give very complete data on all growth relationships, but at a great cost of effort and time. As American foresters have to deal with a large number of commercially and silviculturally important species, most of them ranging over large and variant territories, they have, and will have for some time to come, to make shift with meager tables of growth. Comparison of existing growth tables for a single species, which have been prepared with the best methods, shows such great unexplained variations between them as to point to the necessity for more numerous studies of growth, so as to determine to some extent at least the various factors responsible for those variations and the effect of those factors in various localities. The purpose of this article is to suggest a way to increase the number of such studies.

There is at present but one well-recognized method of stem analysis. This involves nine main operations.

A. In field:

1. Measurement of average d. b. h.
2. Measurement of height of tree and length of each section.
3. Decade measurements of stump diameter growth.
4. *Decade measurements of diameter growth at the upper end of each log along the average radius.*

B. In office:

5. Preparation of volume table.
6. Constructing diameter growth curve by plotting growth of *each tree.*
7. Constructing height growth curve.
8. Computing volume of each tree *at end of every decade.*
9. Constructing volume growth curve by plotting volume of each tree at end of every decade.

[1] Contribution from the Canadian Society of Forest Engineers.

The modified method described in Graves' Forest Mensuration also involves the making of decade measurements at every section, reducing only the office computation.

Graves states in regard to the standard method: "On account of this long and expensive work, relatively few studies of volume growth of individual trees have been made in this country."

On account of the large number of problems confronting the forester engaged in practical work, the opportunities for organizing crews necessary to carry on this work are few and far between. Many occasions arise, however, where a growth study would be made were the undertaking not so formidable. At present the decision usually reached is to confine the investigation to a volume study alone. Usually the opportunity arises in connection with some convenient logging operation. Here lies the chief practical difficulty in the standard method. Only a large crew can secure the large number of measurements required in the limited time usually available between the felling of the tree and the skidding of the logs.

A method seems to be desired that is less laborious not only in the office, but more particularly in the field, so that it can be carried on successfully in connection with any logging operation by a small crew. In the method submitted for consideration, this reduction in labor is secured by changing the procedure of constructing a volume-growth table by which in a great reduction in both field and office work is secured. In the field the work is reduced by substituting for the decade measurements of diameter growth at the upper end of each log merely the measurement of the diameter and the counting of the total age of the section.

Consider what this means. The ages of the sections may be counted along any radius, wherever the rings are plainest and where it is most convenient. The data gathered for each tree go on a single line in the note-book instead of filling a whole sheet. This makes the tallying shorter and the succeeding computations easier. The field-work is reduced fully *one-half,* for the making of decade measurements is without doubt the laborious part of stem analysis. One needs only to try this change once to realize this. It puts the work on a basis where it is comparatively easy to keep ahead of the skidders instead of having to be running continually to the skidway to take the last measurements.

In the office computation there is a similar reduction of 50 per cent in the quantity of work involved. Instead of computing the volume at the end of every decade, only the total present volume of each tree is calculated and a volume table prepared by standard methods. As the diam-

eter growth measurements are not now required for volume calculations, the stump growth may be determined in the direct and simple way. The rings are counted from the pith outward, the growth by decades averaged arithmetically, and a single row of points plotted. When the rings are counted toward the center, the measurements cannot be averaged arithmetically. A d. b. h. growth curve is then constructed from the stump curve in the standard way. The construction of a height growth curve is carried out in the usual way. The most radical change, however, as well as the most substantial reduction in the quantity of work, is in connection with the construction of a volume-growth curve. The d. b. h. and height-growth curves are applied to the volume table and the volume at each decade is secured without any detailed computations.

Thus all the relationships ordinarily worked out when the standard method of complete stem analysis is followed are worked out by this method, with an expenditure of but half the labor involved in the other. The main objections seem obvious and it is not desired to hide or overlook them. They relate entirely to the method of computing the volume growth, as there is no basic change in the method of establishing the other relationships. The method of computing volume growth by applying to the volume table data read from the diameter and height growth curves means that any errors arising from the incorrect drawing of those curves will be carried on to the volume-growth curve and perhaps be distorted there. Each of the curves, however, is constructed by averaging the data arithmetically and plotting only a single row of points. It is found that in most cases the final curves will follow closely these points and the chance of distortion is small. It should be borne in mind, too, that the volume table is based entirely on the same trees that constitute the basis for the diameter and height growth curves.

Another objection that may validly be made to this method is that it does not take sufficient account of the change in form of the individual trees during the various periods of their growth. Since in the volume table the small sizes are most often represented by the smaller suppressed trees of the present stand, the data taken from the volume table may not give the correct volume growth at the earlier ages. This would be overcome to a large extent if the study could be carried out in young stands as well as in old; but this cannot usually be done if a logging operation is being followed.

For the same reason this method may not be well adapted to a study of volume growth in cubic feet, unless the interest centers mainly in merchantable sizes, as would be the case where the object of the study

were to determine the production of pulpwood. The volume table being based on total present volume only, correct figures for the smaller sizes cannot be deduced from it. Thus the volume-growth curve would lack complete data for the early periods or would be inaccurate. The standard direct method gives this data with great accuracy and this proposed method cannot compare with it in that respect. However, for board-foot volume studies, it is not usually difficult to get satisfactorily complete data for all sizes of trees that will yield any quantity of lumber. This objection is therefore not felt to apply where the board-foot unit of volume is to be used, which is usually the case at the present time, particularly for preliminary studies for which this method is suggested.

The details of applying the method may be briefly outlined to show how the various operations of the proposed method are related, so as to at once avoid laborious computation and yet to give a well-related set of data. Many of the operations described are not distinctive of this method, but are described, so as to give a complete view of the working of the method.

For the taking of the field data an ordinary reporter's or stenographer's note-book may be used by ruling lines lengthwise of the book. A single line across both pages may then be used for taking complete data of each tree. This simplifies the taking of notes in the field by making them more compact than where a stem analysis sheet for each tree is used. The headings of the field note-book are as follows:

1. Tree number (serial).
2. Species.
3. Site class.
4. Crown class.
5. D. b. h.
6. Stump: Age, d. i. b., height.
7. Logs 1 (top), 2, 3, etc.: Age, d. i. b., length.
8. Length of top.
9. Merchantable length.
10. Total height without stump.
11. Stump diameter growth by decades (both counted and measured out from center, neglecting odd rings at periphery).

The trees are numbered serially, the numbers being marked on the stumps, so that the measurements at the ends of the logs may be taken first before they are skidded and the detailed stump measurements left if necessary for a short time. The serial numbers also provide for

identifying the data in the note-books during compilation, which is convenient when more than one man is doing the field-work. Bark and sap-wood measurements have been omitted.

It is recommended that wherever possible a sample plot be laid out in advance of the felling crews, the area measured and fully described. After the felling is completed, the uncut trees down to a prescribed diameter limit are calipered. If this is done, there will be available more complete data to serve as a basis for explaining the differences between the tables secured and those prepared in other localities. It is felt that for the purpose of being able to compare intelligently, even volume tables, and more especially growth tables, prepared in different localities, it is desirable that in addition to the data ordinarily published in connection with them there should be stated the number of trees per acre above a certain diameter limit. This can, of course, be done only where *all* the trees cut on a prescribed area are measured and the uncut trees above the diameter limit recorded.

Preparatory to the office computation, the following data are entered in the field note-book. The figures may be inserted above the figures entered in the field.

Length of time to grow from stump height to height of upper end of each log.
Height of section (from stump).
Scale of each log.
Total scale.

For convenience in computation, it is important that the same orderliness be followed in this part of the work as in the taking of field notes. The computation sheets should be preserved the same as the field notes, to facilitate any checking that may seem desirable and to make easier further computations that may be wanted at a later date. The headings of the computation sheet are as follows:

1. Tree number (serial).
2. Height of stump.
3. Stump d. i. b.
4. D. b. h.
5. Volume in feet, board measure.
6. Age of stump.
7. Log 1: Age and height. Logs 2, 3, etc., ditto.
8. Merchantable length.
9. Total height.
10. Decade measurements at stump.

When the computation sheets have been entered up, the field notebooks need not be referred to again. A separate computation sheet may be used for each site and crown class of each species and separate curves drawn for each class. Such classification is not essential and may be varied as desired. To construct average curves for all the trees of each species, the totals of the separate computation sheets of the various classes must be added and general averages secured. If general curves only are desired, one computation sheet for each species is used.

The d. b. h., volume, merchantable length, and total height data in columns 4, 5, 8, and 9 are used for the preparation of a volume table by standard methods. These data are transferred to the computation sheet merely to secure their grouping by species. The data are averaged arithmetically in merchantable length or total height classes and a single row of points plotted for each class. The volume table based on total height is essential in constructing the volume growth curve. A volume table based on merchantable length is usually considered more convenient for use in estimating and its construction is therefore also provided for.

All the other columns and also the total height column are added and the totals divided by the number of trees. The average height and age of each section and of the whole tree are plotted as a single row of points to give a height-growth curve from the stump. Allowance must then be made for seedling height growth. The averages of the decade measurements are similarly plotted to give a stump diameter-growth curve, which is converted into a d. b. h. growth curve by the standard method of allowing for the average differences between the stump d. i. b. and the d. b. h. The reduction in labor in these processes as compared to the plotting of every individual tree should be noted.

The d. b. h. and total height at each decade are now read from the d. b. h. and height-growth curves. The corresponding volumes are read from the volume table, the readings plotted as a single row of plants, and the volume-growth curve drawn through them.

Graduates of Yale forest school will probably recognize many familiar features in the above description. The original features of it were all worked out in connection with the work at the Yale forest school camps, in the Southern States, and this outline is given with Professor Chapman's consent. The main differences between the system outlined above and that followed at the Yale camps are twofold. At the Yale camps a d. b. h.-height curve was prepared by the use of hypsometers, and the height-growth curve prepared by relating the

diameter-growth and the diameter-height curves. In the above outline the height-growth curve is prepared direct by standard methods. Secondly, the various groups of data were secured from separate sets of trees; the volume table data from one set of trees; the stump diameter-growth data from another; the d. b. h.-height data from a third. The disadvantages of these two methods of procedure were pointed out in the instructions given at the Yale camps, but were not followed out for practical reasons and because the main purpose of the work was instructional. With the gathering of all data from one set of trees and the accurate correlation of the same, it is believed that the resulting tables will be of sufficient accuracy to serve most practical needs except for the higher grades of scientific investigation. The above outline, it is believed, provides for this in a satisfactory manner; but the writer wishes to disclaim having any original contribution to the basic principles of the system. The outline has been prepared with the object of encouraging the making of more numerous growth studies by foresters placed in positions where they find it difficult, from a practical standpoint, to undertake an investigation requiring the expenditure of a large amount of labor and the services of an organized crew for a considerable period.

DEVELOPMENTS IN THE MARKING OF WESTERN WHITE PINE (*PINUS MONTICOLA*) IN NORTHERN IDAHO[1]

INTRODUCTION

The work of preparing new marking rules for the white-pine type on the Cœur d'Alene Forest was begun in the summer of 1915 and completed the following year. The work was done under the direction of the Office of Silviculture, in District 1 of the Forest Service. This article attempts to give the results of these efforts.

In order that the reasons for the present system may be clear, a brief outline of the development of marking in the white-pine type, as practiced by the Forest Service in northern Idaho since 1912, is necessary before the most recent marking methods, the basis for them, and the marking rules in detail are given.

Certain economic conditions peculiar to the region have affected the development. The steep, broken topography has been responsible for difficult transportation, high logging costs, and large investment charges. To meet these conditions successfully, now that the most accessible timber has been logged, requires comparatively large unit operations and a large volume of product per acre. As a practical requirement this factor, while it is not of paramount importance with some of the silvicultural factors, should be considered in connection with the establishment of any marking system.

Western white pine, owing to the intrinsic qualities of its wood, is and will continue to be the most valuable species in various mixtures with from one to seven associate species. In fact, white-pine stumpage is worth several times as much as that of any one of its associates in the region at the present time. The purchasers of stumpage demand logging chances containing a high percentage of white pine; because of congressional pressure, the Forest Service has been equally anxious to cut a large proportion of this species in order to increase its receipts. Silvicultural requirements, fortunately, can be met without serious interference with these desires.

The silvical characteristics of white pine and its associates which affect the marking problems are brought out in the statement of scientific facts which is the foundation for the present rules and therefore will not be discussed here.

[1] This article prepared by C. K. McHarg, J. Kittredge, and J. F. Preston. D. R. Brewster, M. H. Wolff, F. A. Silcox, and others have helped to prepare the new rules.

Historical Development

In December, 1912, marking rules were drawn up for the three large logging chances on the Kaniksu National Forest—the Upper West Branch, the Lower West Branch, and the River chances. It should be kept in mind that while these marking rules are of specific application, they still reflect the best information of the time concerning marking principles for the white-pine type. The main points of the Kaniksu marking rules applying to non-agricultural or the areas to be permanently retained for forest management are:

In general, the rules plan to reserve at least 75 per cent of the larch and not more than 25 per cent of any other species. These percentages are by volume.

The stands are classified for marking purposes as:

A. Even-aged, well-timbered land containing a good percentage of white pine; very little, if any, fire damage.

B. Stands broken by fire with considerable advance growth, including white pine to a satisfactory extent.

C. All-aged stands for selection cutting; largely yellow pine and Douglas fir, with some immature white pine.

In Class A stands 75 per cent of the area should be clean cut, leaving 25 per cent of the area in the form of seed blocks and strips. Strips should be at least 100 feet wide on the slopes and at least 200 feet wide on the ridges. No portion of the clean-cut areas should be more than 200 feet from a seed strip or block. Dead timber and cedar poles over 35 feet long can be cut from the strips if the cutting can be done without injury.

On clean-cut areas the only larch cut should be either diseased, suppressed, or very old "monarch" trees. With the exception of small amounts of cedar, larch will be practically the only merchantable timber left on the clean-cut areas.

Class B stands which are merchantable should be cut as Class A stands. The patches of young material are to be left intact, as far as the valuable species—white pine, cedar, larch, fir, spruce, and yellow pine—are concerned. When possible under the natural arrangement, no portion of the clear-cut merchantable areas should be over 200 feet distant from the patches of advance growth left. The object of leaving compact seed patches is of course seed insurance against fire.

Class C stands containing white pine should be cut under the selection system, leaving where possible a thrifty stand of white pine, together with cedar and the usual 75 per cent of larch for a second cut.

These rules simply outlined a mechanical procedure. It was deemed

necessary at that time to provide for reproduction, in addition to the advance growth already on the ground, by reserving from cutting a large quantity (approximately 25 per cent of the volume) of the valuable species. The most practical method of applying the principles was to clean cut between strips or blocks laid out with mechanical precision—that is, perpendicular to the contours and along ridge summits.

Further study brought out new principles, chief among which was a more definite knowledge of the possibilities of reproduction from seed stored in the duff. The advance is shown clearly in the silvicultural plan drafted for the Lolo Creek chance on the Clearwater Forest.

The principal lines of development in the Lolo marking rules are:

1. Recognition of the fact that seed stored in the duff will usually be sufficient for satisfactory restocking.
2. The comparative wind firmness of white pine.
3. The meeting of practical requirements by reserving less merchantable material.
4. More specific classification of the various stands in the white-pine type.

Extracts from the marking rules for Lolo Creek follow. For marking purposes the stand is classified as:

1. Mature white-pine stands.
2. Overmature white-pine stands.
3. Selection stands.

Mature White-pine Stands

These are areas containing upward of 30 per cent of white pine of from approximately 100 to approximately 180 years in age.

The object of marking is to harvest the mature timber by clean cutting, which furnishes the best conditions for white-pine reproduction, and to insure restocking both with white pine and with the tolerant species—cedar, spruce, and white fir—which form a desirable mixture and understory. It is expected that satisfactory white-pine reproduction will be secured from advance growth and seed stored in the duff. Sufficient timber will be reserved, however, to seed areas burned in brush disposal and to insure restocking in case the first reproduction is destroyed by fire.

Approximately 10 per cent of the merchantable volume of the stand should be retained in compact groups, the remainder being cut clean excepting for a few individual white pine, cedar, and larch trees, as noted below. The groups reserved should contain, as a rule, from 12 to 15 trees of merchantable size. The groups should be spaced from three to six chains apart in each direction, reserving on the average one

group on each two acres or five on each 10-acre block. Groups should be located as far as practicable on secondary ridges, knolls, and slopes rather than on flats or in the bottoms of draws. This is desirable (1) to reserve the most windfirm timber, (2) to leave it in the best position for scattering seed, and (3) to retain groups which will interfere least with logging operations.

Groups containing mixed species are preferable to those of pure pine, in order to (1) increase safety from windthrow and fire and (2) insure reseeding of the tolerant species together with pine. On each acre two or three seed-bearing trees each of larch and cedar should be left; where such trees are not included in the seed groups individuals should be reserved outside of the groups. Preferably cedar unsuitable for poles should be left, although if only pole trees are available they should be reserved. The larch are left with the idea that they will last over the next rotation as standards. They should therefore be sound, thrifty trees with well-developed crowns.

In marking, the ground should be laid off roughly in blocks five chains square (2½ acres) and each block looked over for desirable groups. As a general rule, at least one seed group should be retained on each block and five groups on each four blocks. The trees to be reserved in the selected groups and as scattered individuals should be marked conspicuously.

Overmature White-pine Stands

These are bottoms and slopes of the "white-pine type" on which the pine timber is mainly overmature, exceeding 180 years in age, and where the original white-pine stand has usually been largely displaced by tolerant species, such as cedar and white fir. The objects and methods of marking will be the same as in mature stands, discussed above, with the following exceptions:

(1) White pine over 180 years of age will be retained in seed groups only when so defective as to have but little merchantable scale.

(2) When no white-pine timber under 180 years or very defective trees over that age are present, no white-pine trees will be reserved. If reproduction of this species is not secured from seed stored in the duff, planting will be used if possible.

(3) Groups of the other species, giving preference to larch, cedar, spruce, and Douglas fir, will be reserved where no pine is available, to insure natural restocking in case planting is not possible or to furnish a filler for wide-spaced white-pine plantations.

Selection Stands

These include:

(1) Stands in which white pine predominates, 100 years of age and younger.

(2) Slope and ridge stands consisting chiefly of white fir, larch, or Douglas fir, with more or less white pine, and occasionally yellow pine in mixture.

The object of marking is to cut the more mature and defective timber, and to leave a basis for a second cut within from 40 to 60 years, consisting of the smaller and thriftier timber and younger age classes. Occasional patches will be opened up sufficiently to bring about reproduction of the less tolerant species; but this is not an object in marking, which will be governed primarily by the condition of the timber.

The smaller and thriftier timber up to approximately 30 per cent of the merchantable volume should be reserved. In general, trees under 16 inches d. b. h. will be retained unless clearly defective or too crowded, and trees over that size will be cut unless clearly of the younger age classes (under 100 years) and very thrifty or unless required to furnish seed of desirable species or in grouping the remaining timber to prevent wind injury.

Former Cœur d'Alene Rules

In applying these rules to the Cœur d'Alene region only slight variations were made. Two classes of stands were recognized—the young or selection stands and the mature stands. It was also considered advisable to employ a higher volume percentage, from 10 to 15 per cent in the seed-group reservations.

The points in the Lolo Creek silvicultural plan which are at variance with the most recent ideas and field practice are the classification of stands, the universal application of the seed-group system to the so-called "mature" stands, and the reservations for seed and fire insurance based on volume percentage. The reserving of trees from cutting based on a definite volume percentage did not always result in good silviculture or good economy. Under certain conditions, 10 or 15 per cent of the volume is the proper reservation, but with a shift of conditions this may be more or less than is necessary for silvicultural reasons.

The whole idea of the new rules is to outline certain fundamental guiding principles and give the established facts concerning the life histories of the different species of trees with which the marker is to deal, but leave the specific application of them to be determined after

a consideration of the particular problems involved in the marking of each sale area.

There are four important fallacies in the old rules which the new ones are designed to avoid:

(1) Any comparison of the volume of seed trees or other trees to be left to the volume of the original stand.

There is no necessary relation between the board-foot contents of the trees to be left and their value for seed or for future growth. Their value for either purpose depends upon the size of the crowns, the thriftiness of the trees, their distribution over the area, their windfirmness, etc. The per cent of volume left is interesting, but is positively detrimental as a guide in marking. A possible exception would be a case of partial cutting where it was important to insure a second cut within a fixed period.

(2) The idea that groups of seed trees are essential *in every case* of clear cutting.

Experience has proven that they are not needed in most cases.

(3) The reservation of white-pine trees as seed insurance against fire.

White pine is more susceptible to fire damage than most of the associated species. In case of fire after reproduction is established (which is expected from seed stored in the duff) it is practically certain that the seed trees would be burned as well as the young trees. Larch and Douglas fir are two very fire-resistant species which usually occur with white pine. For purposes of insurance against fire these species are the only logical ones to reserve.

(4) A classification of stands based on the age of the timber.

There is no relation between the age and size of trees in crowded stands. Numerous examples of even-aged mature stands have been found which should properly be handled by a partial cutting because of the very great range in diameters and heights. However, in accordance with the old marking rules, the marking of such stands followed the instructions for "mature stands," which prescribed clear cutting with groups and specified not less than 15 per cent of the volume of merchantable trees to be left. Obviously, under such conditions a clear cutting was impossible, and attempts to form groups and to leave 15 per cent of the merchantable volume resulted in immediate loss of revenue, eventual loss (through decay) of trees now merchantable and ready to cut, and in no benefits silviculturally which could not be obtained in other ways.

Necessity for a Change

The increase in logging activity in the Cœur d'Alene region during the last two years has brought out very definitely the difficulties in the field application of the former marking rules for the white-pine type. After a full appreciation of these difficulties, a study of the situation was made, and this, together with additional studies by the investigative force, has resulted in the affirmation of suggested theories and the discarding of old fallacies, making it possible to work out more satisfactory marking rules.

Present Marking System

In drawing up the present marking rules, three objects were kept in mind. The first was to make the rules so clear and definite that there could be no doubt as to their meaning or differences of interpretation by the men who would use them. This of course was largely a question of concise and definite English.

The second purpose was to allow flexibility of application. The variations in composition, size, and condition of virgin stands in the white-pine type are almost limitless. For that reason a set of marking rules to be of any value must be in the form of general principles which will permit adaptation to the different type conditions which occur. Wherever it was necessary to define diameter limits or number of trees per acre to be reserved, the limits were stated as a *minimum* or maximum number per acre *between* certain diameter limits, if any were specified. Particular emphasis has been placed upon the necessity for a specific marking plan for each chance which will show the definite application of the general rules.

Finally, the attempt was made to formulate rules which would be usable by the timber-sale force with a minimum of interpretation and instructions by experts. For this purpose the classification and treatment of the various classes of stands have been based upon diameter breast high and number of trees per acre, with intentional avoidance of reference to age and maturity, which are more difficult to determine and more subject to differences in individual judgment. This basis for the rules may seem to be artificial, but in practice it is not, because the success of the marking under this system, as under any other, depends upon the skill of the marker in selecting the individual trees to be left which will fulfill the purpose for which they are reserved. Training, experience, and judgment are needed in order to decide upon such matters as soundness, thrift, seed-producing capacity, and windfirmness, which determine the suitability of trees to be left.

The silvicultural objects to be secured in marking each class of stand are incorporated in the rules. In addition to these objects, there is the further definite and reasonable purpose to meet practical logging requirements by designating as large a percentage of the total stand as is consistent with good silviculture from the species which are marketable at a profit on their own merits and within these species the largest amount of merchantable material.

The marking rules as outlined for the Cœur d'Alene Forest, together with the silvical data on both white pine and its associates, which have a bearing on marking and which form the basis for the rules, are believed to be of sufficient interest to be given in detail:

Marking Rules for Stands of the Western White-pine Type on the Cœur d'Alene National Forest

January 15, 1917

PART I

Classification of Western White-pine Stands

A. Stands which contain a minimum of about fifty trees per acre, between 6 inches and 14 inches d. b. h., thrifty trees suitable to increase in growth after a cutting and exclusive of hemlock and defective trees of other species.

1. Stands which contain practically all trees below 14 inches d. b. h.

2. Stands which contain sufficient trees over 14 inches d. b. h. to justify a logging operation.

B. Stands which contain less than about fifty trees per acre, as described above.

1. In which small trees of desirable species between 6 inches and 14 inches d. b. h. occur frequently.

2. In which there are practically no small trees, but in which there are thrifty trees, including some white pines, capable of living through a second rotation.

3. In which there are no white-pine trees evidently capable of living through a second rotation.

PART II

Objects of Marking

These rules are in accordance with, and Parts I and II contain the subject-matter in modified form of, the rules for the white-pine type as a whole, which have been approved by the Forester and are given below.

MARKING RULES FOR THE WESTERN WHITE-PINE TYPE

Timber in the western white-pine type will be marked for partial cutting whenever there can be left fifty or more thrifty trees between 6 inches and approximately 14 inches d. b. h. of desirable species. This partial cutting will be a thinning and light improvement cutting in pole stands. In older stands it will be a cutting to a flexible diameter limit of 14 inches to 16 inches for white pine,

but at least an average of six white pines will be left per acre to furnish a supply of seed of this species in the duff at the time of the second cutting. An essential feature of these partial cuttings will be as even a distribution as possible of the thrifty trees left to secure good growth. After white pine, the species to be favored in marking will be spruce, cedar, larch, and Douglas fir, in the order named.

Whenever it is impossible to leave at least fifty thrifty small trees, exclusive of hemlock, per acre, the timber in the white-pine type will be marked for clean cutting, with the reservation of seed trees, and the stand will be reproduced. To supplement the supply of seed in the duff, white-pine seed trees, two to six per acre, depending on size, will be left, together with any thrifty white pine below 14 inches d. b. h. and any small thrifty trees of other desirable species. Seed trees should be thrifty, windfirm trees of seed-bearing size and condition and capable of living until the reproduction will reach merchantable size. In addition to the white-pine seed trees, from two to six larches, or, if suitable larches are not present, Douglas firs, will be left to insure reproduction in case of fire. Where cedar is desirable as a part of the new stand, seed trees of this species should also be left.

Where it is possible to select groups of short, full-crowned trees on ridges, the seed trees on adjoining slopes should be combined in these groups. If the ridges are not pronounced, or if there is no marked difference in the timber, no attempt should be made to leave the seed trees in groups.

Good-sized reproduction openings of not less than one-fourth acre in size will be made, from which all shade will be removed as much as possible. This will involve the marking or designating for cutting of all merchantable spruce, white fir, and hemlock. In addition, it involves the cutting or killing all other hemlock, all trees unmerchantable on account of defect, and all defective white fir. Thickets of white fir and hemlock reproduction which will interfere with white-pine reproduction will be destroyed. Ordinarily, sound small trees of white fir will not be cut or killed unless necessary in order to open the stand enough for thrifty white-pine reproduction.

A small proportion of the white-pine type now bears an overmature stand in which there are very few trees capable of living until the reproduction reaches merchantable size. In these stands all pines below merchantable size and all pines suitable for seed trees, as previously described, will be left, together with white pines unmerchantable on account of defect. White-pine reproduction will be expected chiefly from seed in the duff, to be supplemented by the planting of blanks if necessary. Provision for seed production of other species should be made by leaving seed trees of larch, cedar, spruce, and Douglas fir, giving preference in the order named. The ground should be cleared as much as possible of all other trees.

The district forester will issue such supplemental instructions as may be necessary to put the foregoing rules into effect.

H. S. Graves, *Forester.*

Approved December 20, 1916.

A. To secure a second cut from trees already established.

1. By an improvement thinning.

2. By a partial cutting to harvest the merchantable timber and leave a sufficient stand to utilize the productive capacity of the site and incidentally to secure reproduction in unavoidable openings.

B. To harvest the crop and establish a new stand of white pine and other desirable species and incidentally to secure the benefit of increased growth on any trees which may be left.

Application to Classified Stands

A. 1. Improvement thinnings will be made in these stands whenever practicable.

A. 2. In these stands a partial cutting will be made which will leave not less than fifty trees per acre and preferably more. These will include trees 6 inches d. b. h. and over, exclusive of hemlock and defective trees. A flexible diameter limit of 14 inches to 16 inches will be used as a guide in leaving a sufficient basis for a second cut. Where this will result in leaving less than six white pines per acre, the diameter limit will be raised to provide for at least this number.

The aim will be to secure an even distribution of thrifty trees which will have sufficient space for subsequent crown development. This may involve the leaving of trees above the general diameter limit or the cutting of some below.

After white pine, the species to favor will be spruce, cedar, larch, and Douglas fir, in the order named.

B. 1. The merchantable trees will be cut with the primary object of securing reproduction. To supplement the supply of seed in the duff, two to six white-pine trees of seed-bearing size and condition will be left per acre; also two to six trees per acre, preferably of larch, or, if larch is not present, of Douglas fir, should be reserved as seed insurance against fire. The number of seed trees will vary inversely as their seed-productive capacities. Two trees 18 inches or over d. b. h. may be considered the equivalent in seed-productive capacity of six trees 12 inches or 14 inches d. b. h. As far as possible, seed trees should be selected with reference to their windfirmness.

In addition to the prescribed reservation of seed trees, any thrifty white pines below 14 inches d. b. h. should be left.

Where it is possible to select groups of short, full-crowned trees on ridges, the seed trees on adjoining slopes should be combined in these groups. If the ridges are not pronounced, or if there is no marked difference in the timber, no attempt should be made to leave the seed trees in groups.

Spruce, white fir, and hemlock will be cut to the lowest merchantable size. Where cedar is desirable and should be favored, seed trees of this species may be left.

In general, reproduction openings must be at least one-quarter acre in extent to be effective. This involves the cutting or killing of all hemlock, all defective white fir, and trees of any species unmerchantable on account of defect, and the destruction of all thickets of white fir and hemlock reproduction which will interfere with white-pine reproduction. Ordinarily sound, small trees of white fir will not be cut or killed unless necessary in order to open the stand sufficiently for thrifty white-pine reproduction.

B. 2. These stands will be clean-cut, with the reservation of two to six seed trees each of white pine and larch or Douglas fir per acre, as specified under B. 1.

B. 3. White-pine reproduction will be expected chiefly from seed in the duff, to be supplemented by planting of blanks if necessary. White pines should be left as seed trees only when they are unmerchantable on account of defect.

Further provision for seed production should be made by leaving seed trees of mixed species, giving preference to larch, cedar, spruce, and Douglas fir, in the order named. The ground should be cleared as much as possible of all other trees.

If it proves necessary to plant such areas to secure a good proportion of white pine in the reproduction, broadcast burning will be employed to dispose of the brush and only larch seed trees need be left. Broadcast burning and planting will not be employed, however, without the specific approval of the district forester.

PART III

Scientific Facts Concerning the Life History of Western White Pine Which Have a Bearing upon Marking

Reproduction After Cutting

(1) Reproduction of white pine may be expected from seed stored in the duff, if the seed is not destroyed by fire. The intensity of a fire which is sufficient to kill the seed stored in the duff has not been determined.

(2) The number of seedlings per acre resulting from stored seed depends upon:

> *a.* The quantity of seed stored (largely dependent upon the number and distribution of seed-bearing white-pine trees in the original stand. Investigations indicate that from 300 to 5,000 seedlings per acre may be expected).
>
> *b.* The amount of light the seedlings receive after germination. (White-pine seedlings require full light for the most profitable growth, but the proper size of opening in crown cover has not been determined.)

Germination of Seed

The bulk of white-pine germination from seed stored in the duff appears to take place the second season after the stand is cut, although some germination occurs the first, third, and fourth seasons. White-pine seedlings germinate well on all surfaces—mineral, duff, rotten wood, and humus. Mineral soil, if moist, otherwise mineral soil covered with one-half to one inch of duff, provides the most favorable seed-bed.

Development After Germination

White-pine seed will germinate under dense shade, but evidence has been secured to indicate that seedlings which do germinate under dense shade will usually die. Satisfactory growth will take place only when the seedlings are given plenty of light. Investigations indicate that 50 to 100 per cent of unobstructed overhead light is necessary.

Seed Production

White pine is comparatively a light seed-producer. Fair to good crops of white-pine seed occur at intervals of two, three, or four years. Fully stocked stands usually contain enough seed to completely stock the ground with seedlings within ordinary migrating distance of parent trees.

Seed Production from Individual Trees

Studies on the Cœur d'Alene indicate that trees begin to produce seed when about 8 inches d. b. h., and that the maximum seed production occurs in trees from 15 to 25 inches d. b. h., of from 5,000 to 11,000 seeds per individual tree.

There seems to be no definite relation between size of tree and germination per cent of seed produced. The curve rises rapidly to trees of 8 inches d. b. h., and then gradually falls off in trees from 8 inches to 25 inches d. b. h.

Cone production begins on trees of 8 inches d. b. h., and all the trees from 20 inches to 30 inches d. b. h. bore cones.

The number of seed produced per tree, averaged by d. b. h. classes, increases from a few hundred at 8 inches d. b. h. to a maximum of 7,500 at 25 inches to 27 inches, after which it begins to decrease again.

On the basis of the above data, it is estimated that the number of good white-pine seed per acre to be expected is 2,875 of old seed stored in surface duff, plus 5,000 additional seeds from each seed tree 16 inches to 18 inches d. b. h. left after cutting. Owing to failure of the seed to develop from various causes, 5 per cent of these figures should be a conservative estimate of the number of healthy plants per acre to be expected from this seed at the end of the second year.

Combining these figures for one to six seed trees per acre of this size reserved, the following results in number of healthy white-pine seedings per acre are indicated:

Number of seed trees 16 inches to 18 inches d. b. h. per acre reserved.	Number of white-pine seedlings per acre to be expected after two years.
1	420
2	700
3	980
4	1,260
5	1,540
6	1,820

Seed Distribution

Seed will be distributed, in a sufficient amount for satisfactory reproduction, to a distance of from two to five chains from the parent tree, depending primarily upon the size of the crown and the tree's strategic location.

Competitive Strength

If given an equal start with other species, white pine will unquestionably form a considerable part of the dominant stand. Even a relatively small number of white-pine seedlings per acre, other conditions being equal, will outstrip other species and form the dominant stand.

Recovery After Thinning

White-pine trees, after being badly crowded in dense stands, will increase in growth when the stand is thinned.

Fire Resistance

White-pine trees of any size are easily killed by fire, even by light ground fires.

Windfirmness

White pine is reasonably windfirm, and no special precautions need be taken to prevent windfall.

Relation of Size and Age

There is no definite relation between size and age of white-pine trees in crowded stands.

Associate Species

1. *Western Larch.*—Larch is the most fire-resistant species in the type, and it is, therefore, a suitable tree to reserve for seed insurance against fire. It is windfirm when thrifty and full-crowned, but small, slender trees of sapling size are subject to windthrow and windbreak. Though the tree is subject to fungus diseases and serious injury is caused by mistletoe, it is fairly sound and long-lived.

Large trees of the veteran type are not infrequently unmerchantable because of windshake. Very old and exceptionally swell-butted trees may usually be expected to be shaky throughout, though this is not an infallible indication.

2. *Douglas Fir.*—Douglas fir is reasonably fire-resistant. It requires less moisture than larch, and it is therefore very desirable on the dry sites in mixture with white pine. On the more severe sites it is usually free from defect, but on the best white-pine sites medium-sized trees, even though free from defect, cannot be expected to live through a second rotation and reach maturity in a sound condition.

3. *Hemlock and White Fir.*—Hemlock and white fir are commonly defective. They are prolific seed-producers, and restocking frequently occurs at the expense of other more desirable species. Because of their tolerance, advance growth may be established in small openings and under shade. Whether the trees are favored or not, restocking will usually take place.

4. *Western Red Cedar.*—Cedar is a very desirable tree silviculturally as an associate of white pine. It is very tolerant, and if the tree is present in the original stand and properly favored an understory may be expected. It is easily damaged by fire. Large-sized veteran trees are commonly defective; but they will live for an indefinite period in an apparently healthy condition when nothing but a shell remains of the trunk. Such trees, although unmerchantable, may have a definite value for seed production.

5. *Engelmann Spruce.*—Spruce is only present on the cooler sites of the white-pine type, but because of its desirability it should be encouraged to extend its range. It is relatively tolerant, and will live under partial shade. It is easily killed by fire, and is peculiarly subject to windthrow because of its shallow root system. While it is susceptible to fungus infection, it frequently remains sound indefinitely and is longer-lived than most of its associates.

6. *Lodgepole Pine.*—Lodgepole pine rarely occurs on white-pine sale areas, though it is found in mixture at the upper limits of the type. It establishes dense stands of reproduction, especially after fire, and is therefore undesirable during the period of restocking. It is comparatively short-lived, and in white-pine stands it usually dies out because of its intolerance.

7. *Western Yellow Pine.*—Yellow pine occurs occasionally in white-pine stands. It is very fire-resistant, long-lived, and suitable for seed insurance.

PART IV

General Treatment of Associate Species of White Pine

1. *Western Larch and Douglas Fir.*—On the best white-pine sites larch, because of its relatively higher resistance to disease over long periods, should be considered more desirable than Douglas fir, while on the more severe sites Douglas fir should be given the preference.

These species will be depended upon for seed insurance, and reservations are to be provided for this purpose. Veteran larch, free from disease, but unmerchantable because of windshake, may be used to fulfill the seed-insurance function when other trees are not available.

2. *Hemlock and White Fir.*—Hemlock and white fir are the least desirable species. It is desirable that they be cut to the lowest merchantable limit, and this will be done in reproduction cuttings. All hemlock and all defective white-fir trees, and as much as possible of the reproduction of both species, will be burned, slashed, or girdled. In partial cuttings, and as a rule in reproduction cuttings, where there are several white-pine trees per acre below 14 inches d. b. h., sound, thrifty white firs above 4 inches d. b. h. will not be slashed or girdled. In other reproduction cuttings, except where such trees occur in patches, they will be cut or killed when they will interfere with white-pine reproduction.

3. *Western Red Cedar.*—Cedar should be favored wherever it occurs. Ordinarily all trees which will not make a 30-foot pole should be left, and defective, overmature trees, which represent no investment, will frequently be desirable for seed production.

4. *Engelmann Spruce.*—Spruce should be favored equally with cedar. Grouping of reserved trees is almost always essential for protection against wind, and in general no reservations should be made unless compact groups of pure or mixed character are possible. No reservations should be made on wet flats.

5. *Lodgepole Pine.*—Merchantable lodgepole trees should be cut.

6. *Western Yellow Pine.*—Where yellow pine occurs, it should be favored equally with larch and Douglas fir. It is particularly desirable on dry sites.

PART V

It is the intention of these marking rules to outline general principles and suggestions of broad application for the guidance of marking officers. Field practice will be carried on under specific rules drawn up for each logging chance based on these type rules. On any logging unit areas of different classification will usually occur, to each of which the proper marking principles, as previously outlined, should be applied. The specific marking rules and a marking map showing the application of the rules will be submitted to the approving officer.

Specific Rules

In order to intelligently mark the timber on any sale area, the marker must be able to get a perspective of the timber body. He must prepare a map showing the variations of the type as recognized by the marking rules. To do this he must secure a tally showing the number of trees of different diameter classes, both suitable and unsuitable silviculturally to be reserved. The divisions into

classes will necessarily be broad, disregarding many minor variations. Without such a picture to guide the marker, there will be no consistency of purpose and no uniformity of results.

The map is supported by a tabulation showing the classification of the stand and the results to be expected from the application of the marking rules. If the original timber estimates are made by types and age classes, these data can be obtained without much additional field-work; if not, some field tallies will be necessary.

WHAT IS A BASIS FOR YIELD TAX?

By F. Roth

Professor of Forestry, University of Michigan

With more than 60 years' supply of merchantable timber now on hand and with supplies in the West which may last beyond a hundred years, it is not surprising that the matter of forest taxation is decidedly a burning question over large districts, and promises to continue so for a long time.

For the wild woods, unorganized and merely held for speculation and future exploitation, the yield tax as a fair and just form of taxation appeals to our people as does no other form of tax. That this yield tax should be reinforced by a land tax is merely a matter of compromise to secure continuous income for local development.

But what shall the yield tax be? Shall it be 5, 6, or 10 per cent of the stumpage value of the timber cut? And if the yield tax is made 10 per cent of stumpage cut, how does this tax compare with the $12 per $1,000 which the farmer generally pays in the United States on a two-thirds assessment of his land; in other words, does the forester who pays a yield tax of 10 per cent pay as much or more tax per $1,000 worth of property than does a farmer who pays $8 per $1,000 (*i. e.,* 12 per cent on two-thirds assessment)?[1]

Pennsylvania, in her new law, places the yield tax at 10 per cent; Massachusetts at 6 per cent; Connecticut at 7 per cent for wild woods and 10 per cent for plantations. Massachusetts alone makes an effort to determine the basis for the tax rate and to place it in harmony with general taxation of property in that State. The method employed by Massachusetts assumes an average tax rate for the State; a Y_r of $240; a rotation of 50 years, and then makes a combination of yield tax and land tax in such a manner that the basis fails entirely at any reasonable rotation, say at 80 or 100 years. In my *Forest Valuation,* pages 117 and 118, an attempt is made to develop a proper basis for a yield tax by a comparison in which a regulated forest, with yearly income, is assumed to be taxed like a farm, on a basis of its income value and the general tax rate of $12 per $1,000.

[1] The U. S. Dept. Agr., in Cir. 132-A, 1913, places the tax rate for United States farm property at $6 per $1,000, which is probably nearer the true average than $8 per $1,000.

This comparison is based on the following generally accepted principles:

1. The forest property should not pay more taxes than other similar property.

2. If it is fair to assess farms on the basis of the crop which they produce or the income which they can make, this same method is fair for the forest.

3. If it is fair and customary to use 10 per cent to capitalize the income of a house and lot in town, or the income of a farm to find the value of these properties for purposes of loans or assessment, then it is also fair to use 10 per cent in valuation of forest properties. The principle here evidently has always been that the estimate should be conservative; that the bank takes risks; that the owner takes risks, while the State takes none.

4. A yield tax which is fair for a rotation of 60 years should be fair for any other *reasonable* rotation. What is reasonable here is evident; it means any rotation which gives a fair income or keeps a fair proportion between income and expenses.

5. A yield tax which is fair for one stand should be fair for any other stand, or for any combination of stands of timber, regardless of the methods of silviculture or regulation.

In the volume referred to, a short table is added to show how this comparison appears for a regulated forest with rotations of 50, 75, or 100 years.

The following table shows the same on a little different premises:

Yield Tax Based on 12 per Mill Property Tax at Full Value Assessment

Premises: *Spruce,* site II.; clear cut and planted.
Gross income $= \frac{1}{2} (Y_r + \Sigma T_q)$ as per Schwappach.
Planting cost, \$10 per acre.
Current expenses, \$1 per acre and year.

Rotations, years	60	80	100	120
Area (minimum) of regulated forest, acres	60	80	100	120
Gross income $= (Y_r + \Sigma T_q)$ for *r* acres	\$320	\$654	\$915	\$1,135
Yearly expenses on *r* acres	\$70	\$90	\$110	\$130
Net income from *r* acres	\$250	\$564	\$805	\$1,005
Income value of *r* acres on basis of 10 per cent	\$2,500	\$5,640	\$8,050	\$10,050
Tax as property tax, 12 per mill, on *r* acres	\$30.00	\$67.50	\$96.50	\$120.60
Property tax per acre	\$0.50	\$0.84	\$0.96	\$1.00
Yield tax, *i. e.*, property tax as per cent of cut	9.4%	10.3%	10.4%	10.6%
Property tax as an income tax on net income	12.0%	12.0%	12.0%	12.0%

For *Pine,* site II, the values, under the same conditions, are:

	Per cent.
Rotation, 60 years, yield tax	8.4
Rotation, 80 years, yield tax	9.1
Rotation, 100 years, yield tax	9.3
Rotation, 120 years, yield tax	9.5
Rotation, 140 years, yield tax	9.6

For *Oak,* site II, and taking the full values as given by Schwappach, the values run from 10 to 10.8 per cent for rotations from 80 to 200 years.

This comparison may be put into the following general form:

$$\frac{(A - A\,(\,.0p_x) \times 10 \times \frac{12}{1000} \times 100}{A} = p_y$$

where $A =$ gross income.
$p_x =$ per cent which expenses are of the gross income.
$p_y =$ per cent of yield tax under the conditions assumed, particularly the 12 per 1,000 property tax rate.

The above general form reduces to:

$$(1 - 0.0p_x)\ 12 = p_y$$

In a concrete case: If the expenses are 30 per cent of the gross income, then $\left(1 - \frac{30}{100}\right)\ 12 = 8.4$ as the per cent of yield tax. In other words, where the expenses are kept at a certain proportion of the gross income the yield tax remains constant, as per the above method of calculation.

Since the expenses in any business naturally are adjusted to the gross income as far as possible, and also since the expenses in regular forestry work are commonly stated as a per cent of the gross income, this statement is convenient.

What is the per cent which the expenses make of ordinary gross income?

In farming, it runs from about 50 per cent to 80 per cent and varies much with crop and season. In forestry it is evidently much lower, as shown by the statistics of the German State forests, which are managed economically, but not with any false economies. According to Endres, Graner, and others, the expenses are about 30 per cent of the gross income in Württemberg and Saxony and about 50 per cent in Bavaria and Prussia, with a tendency to decrease. For various reasons, it appears doubtful if this per cent will ever go below 30, but it is also quite certain that it will not, should not, and need not go above 50 per cent.

In applying the yield tax, then, the range of values should be between 6 and 8.4 per cent, on the assumption that the forest pay an equivalent of a property tax of 12 per mill on full assessment. If the forest share with the farm and assessment at two-thirds value, and thus pay a property tax of about 8 per mill, then the yield tax should range from 4.0 to 5.6 per cent, according to the per cent of expenses allowed. Since in all estimates for purposes of taxation the custom calls for conservative work, it would seem fair to allow 40 per cent for expenses and put the yield tax at round *5 per cent universally*.

That the addition of a land tax is not fair is self-evident. Just how to handle this phase is optional. Pennsylvania pays this tax as a State; in the other States the owner pays, either at a limited rate (Connecticut) or on flat assessment (Massachusetts). A flat rate of about 3 per mill on actual sale value of the land seems better than to confuse assessments by assuming a uniform price or value of the land.

That it is not possible ever to have a yield tax which would be mathematically accurate and just for all cases, is evident; there is no method which furnishes such standards. It is also to be expected that in forestry, as in farming, certain methods and costs must be agreed upon. In farming the income which the farm actually makes and the income which the assessor believes can and should be made do not always agree, but the fairness of the method of land assessment remains accepted by the people.

In applying the yield tax in practice the rotation which is too short to furnish an income fairly commensurate to expense and investment will be penalized. The method of silviculture fares better, for penury in silviculture may seriously reduce the income; but it is apt to reduce the expenses even more, and thus enable the payment of a yield tax as high as is possible under better methods.

In the final development of forestry the yield tax must probably give way to better methods, for it is irksome; in small properties, such as woodlots, it has no real place.

But for a beginning, in our wild woods it may help matters a great deal, and such a law as that of Connecticut evidently appeals to forest owners.

With the above basis assumed as correct, however, the Connecticut law demands far more taxes from the forest than it gets from the farm, and it might well be revised and the following values substituted:

Yield Tax in Connecticut, Law of 1913, as It Is and as It Should Be

Timber cut during—	Yield tax: Present low rate	Yield tax: Suggested rate
	Per cent	*Per cent*
First decade	2	1.1
Second decade	3	1.5
Third decade	4	2.1
Fourth decade	5	2.8
Fifth decade	6	3.7
Sixth decade and later	7	5.0

In the above suggested values, the 5 per cent final is discounted at 3 per cent compound. In the present low scale this was evidently not done, and the man who cuts during the first decade pays really 9 per cent yield tax, while the man who waits 50 years pays only 7 per cent.

That the 10 per cent yield tax for timber raised in plantations seems an unfair punishment of the people who plant, is evident, and also that the addition of the yearly land tax makes the burden still more disproportionate and unfair for the forest.

Interesting, in this connection, is a comparison of the taxes per acre of land area derived from the forest as against farm.

In farming, even if buildings, stock, and all is included, the tax on the average farm of the United States is, with total value of farm at $6,443 and area 138 acres:

(*a*) On 8 per mill, $51.44, or 37 cents per acre.

(*b*) According to U. S. Department Agriculture, in Circular 132-A, $38.66, or 27 cents per acre.

Allowing only 25 per cent for value of buildings, implements, and live stock, the tax per acre of land is about *21 to 27 cents*.

In forestry, the land is constantly covered with a growing stock, the larger portion having a fair sale value or market value at any time. In fact, this growing crop or growing stock is normally worth three to five times as much as the land.

The result is just what one expects, that *forestry pays a much larger tax per acre* than does farming. Thus, in the table for spruce, site II, and at 5 per cent yield tax, the forest would furnish:

> 32 cents per acre at rotation of 80 years,
> 45 cents per acre at rotation of 100 years,
> 56 cents per acre at rotation of 120 years,

clearly showing the tax-producing quality of the forest. And this the forest is required to do on land which on an average is not worth over one-fourth the price of farm land.

SILVICULTURE AT AXTON AND IN THE ADIRONDACKS GENERALLY

By R. C. Bryant

Professor of Lumbering, Yale School of Forestry

On August 31 a conference was held at Tupper Lake, New York, by several Canadian and United States foresters, on the property at one time controlled by the former New York State College of Forestry, at Cornell University.

The purpose of this conference was to study the forest conditions on these lands which have resulted from the work done by the College of Forestry during the period from 1898 to 1903, inclusive. Those present included Dr. B. E. Fernow and Dr. C. D. Howe, of the University of Toronto; Clyde Leavitt, forester for the Commission of Conservation of Canada; R. D. Craig, of the same commission; Ellwood Wilson, forester for the Laurentide Company, Grand Mère, Quebec; A. B. Recknagel, forester, Empire State Forest Products Association; S. A. Gaylord, forester at the Ne-Ha-Sa-Ne Park, and R. Stubbo, his assistant; Professors Spring and Bentley, of the Cornell Forest School; Professor R. C. Bryant, of the Yale School of Forestry, and the six students who were in the Cornell summer forestry camp near St. Regis Falls.

The conference was arranged by the Canadian foresters, who are interested in a study of similar provincial forest lands in Quebec.

The work on the college forest which was inspected comprised plantations and logged-over areas, both planted and unplanted.

The problem the college had to meet was the management of a mixed forest culled for softwood and with an inferior hardwood stand, for which there was no existing local market.

Dr. Fernow created a hardwood market by persuading a cooperage plant and an alcohol plant to locate at Tupper Lake and entering into a contract to annually supply them with a given quantity of wood for the above purposes.

Because of a lack of funds for the development of a proper transportation system to log the areas far removed from places which were used for summer pleasure purposes, the logging operators were started in the Upper Saranac Lake region.

The policy adopted by Dr. Fernow was to clear-cut the areas for hardwoods, leaving only such thrifty hardwoods and softwoods as would be windfirm, and then burn the brush and plant the area with desirable conifers. The latter was done in part, but various contingencies which arose have delayed the reforesting operations to date.

Although a screen of green timber was left along all highways and other avenues of travel, the clear-cutting policy raised a storm of protest from wealthy landowners in the Adirondacks, who desired, and still desire, that the State land shall be kept in a wild condition, as a pleasure ground for themselves. The withdrawal of State aid for the College of Forestry, due to the opposition mentioned, led to the abandonment of all the experimental work which was under way.

It is extremely unfortunate that such a short-sighted policy was adopted by New York State, for it has delayed the practice of forestry in the State for many years, and even now many regard the college experiments as a failure, while as a matter of fact time has shown the policy to have been right. *There is no better vindication of Dr. Fernow's policy than the present condition of the logged-off areas near Wawbeek. All plantations which were made under 12 different conditions have proved entirely successful.*

Some of the early plantations made near Cross Clearing have suffered severely from fire. One of them, on an old field which had a heavy grass sod and a poor, dry, sandy soil, in which Scotch pine, white pine, and Norway spruce had been planted in alternating furrows, was badly damaged by fire. The white pine, most of the Norway spruce, and some of the Scotch pine were killed. The latter, however, have shown themselves to be quite fire-resistant and to have ability to thrive on a poor, sandy soil. Another Scotch pine plantation on a very sour, turfy humus proved successful, showing the tree to be adapted even to such unfavorable sites.

One of the most interesting features of the trip was the visit to the logged-off areas. On one area the timber was cut clear, brush burned, and the area planted with conifers, the planting work being done under poor supervision. Notwithstanding the unfavorable conditions surrounding planting, there is now an excellent stand of young conifers from 12 to 18 feet in height, consisting of an indiscriminate mixture of white pine, Scotch pine, red pine, Norway spruce, and a few scattering specimens of alien species.

The spruce showed an especially favorable height and diameter growth, some being from 18 to 20 feet high and 4 inches in diameter.

Height growth of Norway spruce during the first 6 to 8 years was slow, but for the last 3 or 4 years it has been from 15 to 24 inches annually. It is a tree which gives great promise for pulp purposes in the Northeast.

On the opposite side of the road from this area the land was clear cut and the brush was burned, but the area was not planted because the college was abandoned. The contrast is striking. The softwood reproduction was very largely absent, and hardwood brush of inferior character now occupies the ground to such an extent that planting would not now be practicable over any considerable area. This area showed clearly that in mixed forests satisfactory softwood reproduction usually cannot be secured after cutting except by means of planting.

During the afternoon some of the earliest plantations made by the college were visited. The first plantation, made in 1877 on a poplar-grown slash east of the Ampersand Brook bridge, was found to be in excellent condition. Scotch pine, white pine, Norway spruce, and European larch have all done well, especially the latter, single specimens of which are 7 inches in diameter at the stump and 35 feet high. Norway spruce shows a rapid height and diameter growth, especially during the last 4 or 5 years. Douglas fir and *Abies concolor,* of which there were a few specimens, for some reason have only managed to hold their own, being at best 4 or 5 feet in height.

A plantation made on a cleared-up slash nearby suffered greatly from the thicket of raspberries which came in after clearing; nevertheless, a considerable number of trees survived.

An interesting feature of the conference was the evening session held after the close of the field trip. The chief question which was up for discussion was the form of management which should be applied to the forests of the Adirondacks. Professor Spring and Mr. Recknagel had prepared an outline of silvicultural management which furnished the basis for discussion.

The region was taken up by types, and the following conclusions were agreed upon by those present:

1. *Spruce swamps and flats—*

(*a*) True swamps usually reproduce abundantly to softwoods, especially balsam fir. Windfall usually takes all the larger-sized trees left whose crowns protrude above the general level.

The practice on one forest tract near Tupper Lake is to remove

balsam to 6 inches d. b. h., while in an East Adirondack job balsam is cut to 8 inches d. b. h. with the proviso that the market permits cutting some tall balsam to 6 inches d. b. h. to avoid windfall.

(*b*) Spruce flat. A feasible diameter limit, higher or lower according to danger of windfall and market conditions is recommended. In practice timber may or may not be marked—a difference of opinion existing on this point.

The marking should be in accordance with the judgment of the forester in charge of the operation.

At Ne-Ha-Sa-Ne Park spruce is now being cut to 9 inches d. b. h.; balsam to 6 inches d. b. h., and helmlock to 10 inches d. b. h. Finch-Pruyn in the east Adirondacks cut spruce to 10 inches d. b. h., "paying special attention to the selection of short, stocky trees to be left and removing the tall, spindly individuals which would blow down."

The A. Sherman Lumber Company, in the west Adirondacks, on land which is to be held permanently, cut all softwoods at 12 inches on the stump.

2. *Hardwood land*—

In general, if the softwoods are logged to a diameter limit on hardwood land, there will be no substantial natural reproduction of the softwoods. Under this plan there remain for a second cut merchantable spruce and softwoods, which will, however, have little or no increment or reproduction, potentially commercial, unless the hardwoods are cut.

The management must, therefore, determine whether spruce and other softwoods are to be continued on hardwood land.

If they are, the result may be secured (1) by the simultaneous removal of both softwood and hardwood by selection cutting, which will aim to avoid the effects of complete exposure and to remove overmature and defective trees and leave, so far as possible, young, thriftily growing ones. The fixing of a definite diameter limit is of little moment; in general, the endeavor should be to leave sound, windfirm trees in groups or singly, ranging in diameter from the smaller growth up to 16 inches d. b. h. This method will require skillful marking, probably supplemented by artificial reproduction of softwoods.

(2) Where hardwoods are cut after softwoods have been removed to 10 or 12 inches d. b. h., some softwood reproduction can possibly be secured by the retention of seed trees of those species where favorably located in surrounding hardwood groups so that windfall is un-

likely. The hardwoods left will also prevent undue drying of the soil. Stirring of the soil by steam logging may favor reproduction by exposing mineral soil. It is doubtful if as high a percentage of softwoods in the composition, as originally present, can be attained by dependence on natural reproduction.

The general concensus of opinion was that neither (1) nor (2) would be satisfactory, either in application or in result.

(3) The third possibility is the application of the method followed by Dr. Fernow at Axton, namely, clear cutting, followed by planting, depending on groups on hills and upper slopes of timber lightly cut, for admixture of hardwoods. The species indicated are: Scotch pine on very poor, sandy sites, having sour soils; Norway spruce on better soils, red pine on poor, sandy soils; white pine, European larch, on better soils, and white spruce for pulp. Douglas fir and white spruce are experimental as yet in the Adirondacks.

If softwoods are not to be continued, then on certain tracts it may be to the best interests of the owner to manage his forest for production of hardwoods and to make no attempt to secure softwood reproduction, either naturally or artificially. One cannot gauge the probable future value of hardwoods. If not logged too closely, and if fires are excluded, satisfactory natural reproduction should follow because of more favorable seed-bed and the presence of a large number of seed trees. Also, it will materially reduce the length of time for reproduction to become established and a second cut to be obtained (possibly 40 years as against 80 years or longer).

3. *Spruce slope*—

Clear cutting, if at all, and adequate fire protection. Logging, properly conducted, will leave seed trees, on upper portions of slope and on rocky spurs, of windfirm character and in sufficient numbers to supplement amply reproduction already on the ground. One Adirondack forester recommends that "Upper slopes should be cut clean or left untouched. It is false economy to leave the smaller trees in these exposed areas, as they are certain to be windthrown and form a fire trap besides hindering new growth."

Some recommend a strip system, two tree-lengths wide. This was not regarded as feasible from a logging standpoint.

The Axton trip is a very profitable one for every forester, especially those interested in the problems of the Northeast, and it is hoped that many will take advantage of the first opportunity to look over the work of the former College of Forestry.

ACCELERATED GROWTH OF SPRUCE AFTER CUTTING IN THE ADIRONDACKS

In the course of the work being conducted by the Department of Forestry at Cornell on a tract of privately owned forest land in St. Lawrence County, N. Y. (northwestern Adirondacks), some interesting measurements showing increased growth after thinnings were recently secured. The history of the stand is as follows: In 1898-'99 the original stand of mixed hardwoods and conifers was culled for the spruce and hemlock above a certain diameter limit, leaving the smaller sizes of these two species and some of the larger, but less desirable, specimens growing in a stand so thinned that much additional light was admitted. The growth on the remaining conifers was stimulated to a marked degree—a fact first noticed this year when spruce, hemlock, and balsam have been cut for pulp and bark. The market for pulp has been so good this season that the owner has been induced to cut his pulpwood down to a rather low diameter limit, and in nearly every case the stumps of the trees cut this summer show a period of accelerated growth dating from 1899 or a year or two thereafter. It was a simple matter, during the course of the work of making measurements for volume tables, to ascertain whether or not the growth of a given tree had been accelerated, and in the case of 130 trees out of a total of 235 examined, increased growth was found, beginning about 1899. The stumps of the surrounding trees, cut in 1898-'99, were often sufficiently well preserved to prove beyond the possibility of a doubt that their removal had been the immediate cause of the liberation of the younger conifers, and the consequent acceleration in growth.

In 1915 estimates by the strip system showed a total stand for this type (spruce flat) of 5,432 board feet per acre, of which spruce, balsam, and hemlock amounted to 36 per cent. Computed in terms of cubic feet, these three species yield approximately 900 cubic feet per acre, allowing for the utilization of tops to a diameter of 3 inches. The trees were most of them between 6 and 12 inches d. b. h. (89.5 per cent of the total number per acre fell between these extremes).

Complete stem analyses were made of some of the typical specimens, with the following results:

Species.	D. b. h. 1899. (inches)	D. b. h. 1917. (inches)	Volume 1899. (cu. ft.)	Volume 1917. (cu. ft.)	Rate of increment.[1] (per cent)
Spruce	4.4	7.5	1.8	3.4	3.4
Spruce	4.5	8.1	2.0	7.0	6.2
Spruce	7.8	12.0	7.4	17.4	4.5
Hemlock	11.6	16.3	16.6	26.0	2.5

By using volume tables, and comparing the present volume with that shown by the analysis of stumps to have been present in 1899, a number of other spruces showed an average annual increment of 4.8 per cent. One specimen, disks from which were shown at the meeting of the New York State Forestry Association at Lake Placid on September 7, 1917, and which is now in the museum of the Department of Forestry at Cornell, showed accelerated growth over a period of 18 years, and in the last ten years had grown at the rate of 5.67 per cent in total volume.

These figures are especially interesting at the present time, when pulp wood is commanding such high prices. It shows what can be expected of spruce when timely thinnings are made and the stand opened to admit more light.

JOHN BENTLEY, JR.

For the sake of comparison, the same data were worked up by diameter classes, figuring the current annual increment per cent (c. a. i. per cent) by Pressler's formula and curving the results. From this curve the following table is obtained:

Current Annual Increment of Second-Growth Spruce. Spruce Flat Type, Northwestern Adirondacks.

(Read from Curve.)

D. b. h. (inches.)	C. a. i. per cent (Pressler).	Basis. (Number trees.)
6	6.6	5
7	5.9	5
8	5.4	19
9	5.0	17
10	4.6	9
11	4.3	10
12	4.1	6
13	3.9	..
14	..	1
Total		72

The volume table used was that given on p. 237 of Cary's *Manual for Northern Woodsmen*, Table 6, in cubic feet, interpolating for frac-

[1] By Pressler's formula.

tional diameters and odd heights. The volume of the smallest trees was determined empirically.

Finally, for 10 selected trees the number of years required to grow the last inch of diameter was determined at the time of making the stem analyses and found to be 6 years. The average d. b. h. of these trees was 8 inches. By Pressler's formula, using the square of the diameters (for rough and ready results), the c. a. i. per cent proved to be 4.4 per cent, which compares closely with the results given above by Professor Bentley. Using volumes, the result is 5.15 per cent, which is close to the value in the above table.

A. B. RECKNAGEL.

REVIEWS

Proceedings of the Eleventh Annual Convention of the Empire State Forest Products Association. December 19, 1916.

This association, composed of some sixty-odd lumber and pulp-wood and kindred corporations, timberland owners, and persons interested in forestry, seems, with the eleventh year of its existence, to have taken on new life, with a new constitution and reorganization. The object, as stated in the constitution, would make it appear less a trade association, as one would at first sight assume, than one for public benefit, for, besides promoting the interests of its members, it is "to protect, perpetuate, and increase the forest growth of the State through the establishment of a rational and constructive system of forestry, the conservation and development of water-power in the State of New York, to promote friendly intercourse between the members, and to coöperate with others interested in like objects."

The most important contribution to the proceedings consisted in two after-dinner speeches, not so much on account of the contents as on account of the personalities who made them, namely, Secretary of State Hugo, and Speaker of the Assembly Sweet. Both speeches discussed the forest policies of the State; both were informed and thoroughly rational, statesman-like and not mere politician's clap-trap.

The tenor of the speeches is perhaps best caught by quoting a paragraph of the secretary's remarks, after having traced the history of the Adirondack and Catskill Forest Preserve:

"It seems to me the difficulty is, confusion of thought in the public mind in analyzing the proposition. This confusion is as between the æsthetic value of the Adirondacks and the utility value, and the confusion is due to the fact that the public is not quite clear as to the use they desire to have made of the Adirondacks, and this problem will never be solved until the people of the State have a clear point of view as to whether the Forest Preserve is to be used for park purposes or as a Forest Preserve. The two are not synonymous. The difficulty is, we are trying to do two things that cannot be done at the same time. In other words, the whole Forest Preserve cannot be a public park, without any interference whatever, and at the same time a Forest Preserve, which implies governmental regulation.

"The problem of clearing up this confusion in thought requires courage and education, in order to clear up the hostile attitude at

present in the public mind and to educate the public along the lines of a proper policy in regard to the Adirondacks."

The speeches had particular point from the fact that Commissioner of Conservation Pratt, in whose domain the administration of the Preserve falls, was also present with a well-prepared, dignified statement of the policy actually applied, which naturally keeps within the constitution, by protecting the integrity of the State's title, by protecting the forests from fire and trespass, by reforesting denuded areas (how this may be done and the lands be kept as "wild lands" is difficult to see!), and by making the State lands more useful for hunting, camping, fishing, recreation, and health. Secretary Hugo pertinently asks whether this policy is efficient. "Are the people of the State of New York getting all the revenue they can from the State Forest Preserve without injuring it? We have a right to demand that we shall."

An educational campaign by the association to form proper public opinion was suggested by all speakers as hopeful in results. The fact that another $10,000,000 are to be spent on purchases, in addition to the $7,500,000 already used in making the Preserve, renders the need of a rational policy important.

We may glean a few facts regarding forest conditions in New York from the various speakers.

Nearly 40 per cent of the State (12 million acres) is forest and woodlot, and another 10 per cent may be added of land under farm, not fit for such use. Less than one-half this area is located in the Adirondack and Catskill Mountains. In the Adirondacks the State owns 48 per cent, with 1,700,000 acres (with the Catskill Preserve altogether 1,830,000 acres); 15 per cent is in private parks, and only 23 per cent is owned by lumber and pulp companies.

In 1903 over 450,000 people visited the woods, bringing nearly $9,000,000 to the hotels, in which over $16,000,000 were invested. The Commissioner in comparison asserts that the lumber industry amounts to probably not more than 20 per cent of the business of the Adirondacks. But another speaker points out that the transportation and manufacturing interests, adding to the value of the material, are forgotten in this account, which would make the forest products' end represent more likely as comprising 50 to 60 per cent of the total business of the region.

Three more technical papers were presented by three foresters. Professor Brown, of Syracuse, reported for the committee on forestry,

showing as a result of inquiry that closer utilization is now more generally practiced in the woods by lowering stumps, making logs any length between 8 and 16 feet, taking pulpwood in tops down to 2 or 3 inches, and peeling in the woods, reducing the allowance for trim to 4 inches where logs are driven and 2 inches for railroading. A canvass and translation of all forest products into board feet—a questionable proceeding—makes the cut for 1916 around five billion feet, valued at $107,000,000.

Mr. Tryon discusses forest fire insurance, the difficulties to be overcome and how they may be overcome, and a plan is proposed, briefly formulated as follows:

"The general plan of organization requires, first, the assembling of a number of representative timberland owners sufficiently large to furnish the required reserve and premium. These members are, at their meeting, to exchange among themselves insurance, at cost, on certain restricted, chosen areas offering approximately equal risks. The details of management would be handled by the attorney-in-fact, who would be empowered to act for each and every member. It would be highly desirable to have the risks distributed over a large territory in order to take advantage of climatic variations. Each subscriber is required to take out a line of insurance on standing timber divided into equally hazardous, definitely specified, widely separated sections of territory which have been approved by the managing attorney as good risks. Each subscriber will deposit as his share in the reserve fund a cash sum equal to his annual premium, and will pay in advance a premium of two per cent. Each member will cover the costs of any necessary appraisal work. Now, when a reserve fund has been created, and all debts, future losses, and running expenses of the exchange have been provided against, the supervisors should order the managing attorney to return to each subscriber, at the close of any year, the unused portion of his premium, pro rata. This will give the subscribers insurance at actual cost, as well as a pro rata ownership in the reserve fund."

Mr. A. B. Recknagel, who has since been made Forester to the association, furnishes some interesting statistical data from cut-over hardwood lands under different treatment:

"These figures show conclusively that, after the softwood logging, the hardwoods dominate the stand and, unless the hardwoods are cut, there is very little chance for the softwoods to maintain themselves. 'The reduction and removal of the old hardwoods alone assures success in the silvicultural program of re-establishing and giving advantage to the conifers.'"

We agree thoroughly with this attitude and have successfully proved it correct in the Axton woods.

Two charts are exhibited to show conditions after a virtual clear cut and a conservative cut, showing the latter as securing almost the same amount of material. A period of return of 40 years is suggested for a cut of approximately 10,000 feet.

Experimental cutting of hardwood lands to solve the problem of their regeneration is suggested by the speaker to the members of the association.

We hope that the association will be more active than hitherto in impressing the rational point of view as regards forest policies upon the people of the State.

B. E. F.

Reforestation on the National Forests. By C. R. Tillotson, Forest Examiner. Bulletin 475, United States Department of Agriculture. Washington, D. C. May 28, 1917.

This is an account of seed collection and of sowing and planting operations on the National Forests, replacing Forest Service Bulletin 98. It presents clearly and in detail a large amount of well compiled information, revealing excellent progress by the Forest Service in this line of endeavor. With the many illustrations and the clear description of methods, one can get from this publication a good understanding of artificial forestation as practiced in the various administrative districts of the National Forests.

A double purpose seems to be served by this compilation, representing "the results of the study and experience of many different members of the Forest Service": (1) to give the public, particularly the members of the profession, a knowledge of the present practice of reforestation on National Forests, and (2) to provide a handbook for use by those in the Service engaged in seeding or planting or in its supervision. For the latter purpose it will be especially important, description of methods often falling into the language of instructions.

That part on seed collecting and direct seeding is based on previous publications, but is well presented and has additional material. The use of such terms as "regular seed spots," "simple seed spots," etc., seems unnecessary, since the seed-spot method, or modifications of it, can be described satisfactorily without affixing somewhat inapt terms. Akin to this is the use, in many instances, of the word seed as a collective noun (used, also, by several writers) where the plural, seeds,

would be more expressive in the context. The results from direct seeding are reported as uncertain, and partial seeding in spots is said to be superior to broadcast seeding.

The portion of the bulletin dealing with planting will be welcomed by the profession; its detailed description of practice and the condensed statement regarding possibilities of planting and sowing in the different regions. There is a wealth of excellent details in this part and a final table giving classes of stock for planting, by regions and site (planting area) classes.

From the standpoint of terminology the reviewer regrets the introduction of terms such as "square or deep hole methods," "side hole method," and "cone method." Again, as indicated above concerning terms in seeding practice, it suffices to describe the hole method of planting indicating how the hole is made and how and where the plant is set therein, according to conditions of the planting area.

It is exceedingly interesting to find such a decided trend in planting toward the adoption of the most careful and painstaking methods. It is stated that the slit method is advisable only under conditions very favorable to tree growth. Emphasis is also laid on care in planting.

The designing and use of special tools (of which the bulletin gives illustrations) show a decided ingenuity on the part of forest officers to meet the need for greater efficiency and it bespeaks keen technical interest in planting operations. The silviculturist will find much of interest on the last ten pages of this professional paper in the discussion of planting sites and their comparative suitability for planting and sowing.

This bulletin is a good contribution to the forester's fund of empirical information, but one desires greatly to have a technical report also on this subject from some of the National Forest experiment stations.

SAMUEL N. SPRING.

CORNELL FORESTRY CAMP,
September 4, 1917.

General Survey of Texas Woodlands, Including a Study of the Commercial Possibilities of Mesquite. By J. H. Foster and H. B. Krausz.

Forest Resources of Eastern Texas. By J. H. Foster, H. B. Krausz, and G. W. Johnson.

Bulletins 3 and 5, Department of Forestry, Agricultural and Me-

chanical College of Texas. College Station, Texas. May, 1917. Pp. 47 and 57.

With these bulletins the new State Forester, as it were, lays the foundation for his work, investigating and analyzing the natural conditions of his field of action. Bulletin 3 is a compilation from existing sources and so in part is Bulletin 5, an earnest of more detailed personal studies "as funds are available."

Since Texas is as large as all of the Northeastern States, including Ohio, Kentucky, and Maryland, a detail county by county survey, which Mr. Foster contemplates, will take discouraging time to make this first step, which would be proper if any permanency of conditions is to be foreseen.

It may, however, be questioned whether this step is necessary in many places, if the author's prognostication should hold true, that "the great forest belts of East Texas will eventually become woodlot sections, where the best soils will be in cultivation and the poorer ones devoted to the growing of forests." We are inclined to believe this a likely future, and then the practical issue will merely be to differentiate the line of demarcation between the farm and woodlot soils and situations. To differentiate these should probably be the first step.

The real timber region will then be found to the westward, on the Edwards Plateau and the foothills and high elevation of the Rocky Mountains. Even with the Edwards Plateau the question may arise whether it or most of it should not be turned rather into grazing lands.

In other words, there is no assurance in a country like Texas, in which there is so much agricultural possibility, where the forester may finally find his field.

At present, the eastern timber area is still the most important, although it is already invaded considerably by farms and pastures. In the 40 eastern counties, one-third of the round 21 million acres involved is in farms, one-third is cut-over forest, and the last third is by no means all virgin forest, but interspersed with second growth, culled areas, waste and overflowed lands.

The bulletin devoted to this section gives brief descriptions, county by county, with a physiographic outline, classification of the land area, differentiation of forest types, development of farms and forest industries, and general comment.

The counties are given in alphabetical order, which in the absence of a table of contents or index is desirable, although it destroys an oversight over the natural relationship of localities.

Assuming 9,000 board feet per acre for the 3 million acres of virgin timber, 3,500 feet for the 8 million acres of culled and cut-over lands, and 1,500 for second-growth land, a stand of 56 billion feet is estimated, which tallies about properly with the estimate in 1911 by the Bureau of Corporations. There are 345 sawmills at work; the 66 largest, with an annual capacity of 10 million feet, are located on a map too small to be of value. Of other forest industries the box and crate industry is perhaps the most notable, with 14 mills, 5 of which use over 10 million feet of gum.

In Bulletin 3 a number of small orientation maps assist in the description of the distribution of elevations, geological formations, soils, on which a special chapter is given by the soils agronomist, precipitation, and floral features.

In discussing the distribution of species and of forest types, the authors very properly find the cause not one-sidedly, as is customary, in the distribution of rainfall, but in contributory conditions of soil and drainage and aeration, temperature, and especially winds. While undoubtedly variation in rainfall in Texas is the most potent influence in determining floral distribution in general broad features, giving rise to a distinction of 10 floral belts, the heavy timber in the canyons of the Edwards Plateau, a region of low rainfall, is accounted for by an abundant supply of percolating waters; the absence of tree growth on the waxy clay soils of the Black Prairie, in spite of abundant rainfall, is accounted for by lack of aeration and competition of grasses. Such lack in the compact soils accounts also for tree distribution and types of forest in many parts of the coastal plain. Here the absence of forest conditions also plays a rôle and distinguishes the flora from that farther north and inland.

In the coastal plain the occurrence of hurricanes and of severe winds has a "profound effect on the history of forest extension and on the form of tree growth and of timber, and must be taken into consideration in the methods of planting and the choice of species."

An interesting contribution is made by Forest Assistant Krausz on the commercial possibilities of mesquite.

It is a pity that a species, which so readily propagates itself, overrunning almost the entire State like a weed, exhibits so little commercial value or possibilities. This is due not only to the character of the wood, which is exceedingly hard and at the same time brittle, restricting its use, but also to the character and form of the tree because it grows exceedingly crooked, so that hardly an average of

3 feet, rarely 6 to 8 feet, of straight material, 3 to 4 inch diameter can be harvested, and trees more than 9 to 10 inches in diameter are usually unsound. Moreover, for operations based entirely on mesquite the character of its occurrence is inimical, for in a trip of over 600 miles not more than five tracts, comprising 9,300 acres and containing 6 million feet, measured down to 2-foot lengths, could be found.

The wood can only be used for specialities and novelties, small turnery, such as gavels, goblets, rings, trays, tool handles, possibly parquetry and paving blocks. This would insure about a twelve years' run for a suitable mill.

Mr. Krausz figures out a logging and milling cost of $21 to $27, and describes the way of doing business. Two mills were found working up local supplies. It is quite evident from the report that no industry can be established on this class of raw material, except as a side issue in working up the material coming from the lands that are turned into farms, which requires the digging up of the mesquite.

B. E. F.

The Status and Value of Farm Woodlots in the Eastern United States. By E. H. Frothingham, Forest Examiner. Bulletin 481, U. S. Department of Agriculture. Contribution from the Forest Service, Washington, D. C. 1917.

The purpose of this bulletin, as stated by the author, is "to show as nearly as it can be done from available census statistics what the relation of the woodlot has been to the agricultural development of different parts of the East, what the tendency appears to be, and, in general, what value the woodlot actually has to the nation, the rural community, and to the individual farm."

The farm lands in the Eastern States are grouped in 6 divisions, each consisting of the counties having similar ratios of woodland to the total farm land according to the thirteenth census (1910). These "woodlot divisions," shown graphically on a map, range from light wooded regions (Divisions I) having less than 10 per cent of the total farm land wooded, to heavily wooded regions (Divisions VI), having more than 80 per cent wooded. The tables in the bulletin are based on those divisions, so that the chief facts relating to the status of woodlots in any part of the Eastern States can be easily ascertained.

In order to compare the progress of agricultural development with the decrease or increase of farm woodlot areas, the author has selected

the "value of farm land" and the "proportion of farm land which is improved" as the factors which have the most important bearing on the real causes of woodlot clearing. Table 1 shows the average value of farm land in 1910 for the counties in each woodlot division and Table 2 the proportion of improved land in 1880 and 1910. The general rate at which agricultural development took place between 1880 and 1910 is indicated in Table 3, which shows what proportion of the total land surface was in farms in each of those years. Table 4 gives the acreage of woodland in 1910 and the percentage of increase or decrease since 1880 for each State and woodlot division. The total woodland area in 1910 in the Eastern States was 143,391,568 acres.

These tables show that in general there has been a gradual decrease in woodlot areas. From 1880 to 1890 this decrease amounted to nearly 15 per cent, and was most rapid in the three woodlot divisions now having the smallest proportion of farm land in woods. The decrease amounted to 37 per cent in Division I, 39 per cent in Division II, and 18.5 per cent in Division III; while in Division IV it was only 5.7 per cent, in Division V 0.8 per cent, and in Division VI no decrease at all. In New England there were increases in Divisions III and IV, due chiefly to reforestation of abandoned fields. In the Lake States a large increase is shown in Divisions III to VI, due to the acquisition by settlers of large portions of the timberland. In most of the States the decrease was more rapid in the small woodlot than in the large woodlot region, every State except Minnesota and Massachusetts (Nantucket Island), showing a decrease in Division I, and only four States showing an increase in Division II.

The increase in the proportion of farm-improved land shown in Table 2 for the corresponding division shows that this decrease in the area of woodlands has been caused chiefly by the need of land for cultivation and grazing; but while the increase in total farm holdings was less than 12 per cent from 1880 to 1910, the area of unimproved, unwooded farm land increased over 34 per cent in amount, showing that a great deal of farm land has not been improved when cleared. In the Northern Lake States this can be accounted for by the acquisition by farmers of stump lands not yet in shape for cultivation, and in the East, as a whole, it is probable that the greater part of this class of land has remained idle, partly because the farmer did not have the means to improve it and partly because it was too poorly drained, too steep, or too stony for successful cultivation. The area of unimproved

unwooded farm land in the Eastern States, according to the census of 1910, is 40,429,951 acres, or about 8 per cent of the farm land. Table 5 shows the acreage of improved land and unimproved land, its proportion to the total area of farm land and the proportional increase or decrease since 1880.

The average size of farm woodlots varies from 5 acres in the older farming sections to 150 or 180 acres in the newer ones, such as northern Minnesota. For the Eastern States, as a whole, the thirteenth census shows the average size to be a little less than 30 acres. Table 6 shows the average woodlot acreage per farm in different States and divisions for 1880 and 1910, and Table 7 the average proportion of farm land wooded for the same years.

The value of woodlot products cut each year in the Eastern States has increased rapidly. Between 1880 and 1910 the increase was over 90 per cent, due partly to the rapid rate of clearing and partly to the increase in the intrinsic value of the products. The rate of increase naturally varies with the region. Table 8 shows that the total value of woodlot products in 1909 for the Eastern States amounted to $169,948,468. It also shows the value for each region, with the percentage of increase since 1899 and 1879.

The total stand of timber in farm woodlots is estimated at 174,000,000,000 board feet of log timber and 1,100,000,000 cords of other wood, or nearly one-sixth of all standing timber in the Eastern States. The author states that it is not true that the producing value of woodlots is restricted to the rough product, such as rough lumber for building, cordwood for fuel, posts, ties, poles, etc. Many woodlots contain timber every bit as good as that in larger tracts and fully as capable of yielding high-grade lumber if properly sawed and seasoned. There is hardly a use to which wood is put that cannot be contributed to liberally from the woodlot supply.

As agricultural development proceeds, the decrease in the aggregate area of farm woodlots is bound to continue, but a reduction in the rate of decrease can be expected as the farmers come to realize more fully the advantage of owning thrifty woodlands. Eventually a relatively stable condition of woodlot area will probably be reached, which may vary locally, according to local demand and supply, but for the country as a whole will tend to remain fairly constant. With proper treatment it is not unlikely that the woodlots now existing could be made to yield perpetually an average of half a standard cord of wood per acre per year. At that rate an aggregate annual yield of 71,500,000 cords could

be expected in perpetuity from the present total woodlot area of 143,000,000 acres. If it is assumed that the permanent woodlot area of the future will amount to 10 acres per farm (now 29.2 acres), or a total for the Eastern States of 49,030,850 acres (based on the number of farms in 1910), the sustained annual yield supported by a growth of one-half cord per acre per year would aggregate 24,515,425 cords.

The author discusses the value of the farm woodlot to the nation, to the community, and to the farm itself. Table 9 shows how the woodlot income compared in 1909 with the total farm income in different regions in each State. The value to the individual farm of the woodlot products reported for the 1910 census averaged $81. Table 10 gives the value per farm of the products used and sold in 450 counties selected at random from each woodlot division in each State. The bulletin also discusses the value to the farm of the woodlot for furnishing a home supply of firewood and lumber, as a protection to stock and crops, and as a poor land crop.

The bulletin is full of valuable and interesting data regarding the farm woodlot. It shows what can be done with a bundle of dry statistics by a keen interpreter. But few of the ideas brought out can be presented in a short review. The bulletin makes readliy available, in convenient form, the chief facts relating to the status of woodlands in any part of the Eastern States.

J. A. F.

Report of the Chief Forest Fire Warden for the Year 1916. Bulletin 16, Department of Forestry of Pennsylvania. Harrisburg, Pa. 1917. Pp. 123.

The Department of Forestry of Pennsylvania maintains in its organization a Bureau of Forest Protection, presided over by a Chief Forest Fire Warden, George H. Wirt, whose second annual report is published as Bulletin 16.

From this report it would appear that the warden believes not only in educating the public and the fire wardens under him in the proper appreciation of their interest and work, but he believes also in the expenditure of cash to secure more fully the object of his bureau.

Turning to the financial account, we find that the biennial appropriation for his work in the past two years has been $45,000, while for the following two years the proposed budget is $185,000—four times the previous allowance. Meanwhile the appropriations have been passed and have been cut down to $80,000 for this service.

The warden does not only *believe* in education of the public, but is assisting in it by attending meetings, preparing articles for magazines, and giving special addresses throughout the State. It is perfectly legitimate to enumerate these exhibitions of his activity.

It can only be to the advantage of the fire wardens of each district to arrange for their meeting in order to get acquainted, exchange views, secure coöperation and instruction, the attendance being obligatory; and it is also good policy of educational value to print, as is done in this report, brief accounts of these meetings.

The organization, when completed, will comprise 1,500 to 1,600 men. The State is divided into 21 fire districts, with a district fire warden, who is to have 70 to 80 local wardens under his supervision and 5 to 10 patrolmen or tower observers. The district wardens are to have $1,500 per year; for patrolmen only $200 are allowed, and the local wardens are paid by time. We do not know whether the reduced appropriations will retard and hamper the full organization.

Besides the organization of the official forest fire-fighting force, coöperation with other organizations is diligently fostered, as with the game commission and its game protectors; with the department of fisheries and its fish wardens; with the State police bringing violators to account; with the State highway department in avoiding incendiaries due to carelessness of employees; with the boy scouts and sportsmen's associations; with local protective associations, the Pocono Protective Fire Association, which is claimed to be the oldest of its kind in the United States, and the Central Pennsylvania Fire Protective Association.

The railroads are more and more realizing their obligations by patrolling more assiduously and helping in reporting and fire extinction, in keeping their engines safe, and by settling damages and charges more promptly.

The chapter on legal affairs is particularly enlightening, showing how difficult it is to secure convictions and enforcement of law, when the Attorney General rules out cases in which the conviction is uncertain. A number of cases is cited.

In twenty-nine cases it was possible to secure out of court at least payment for the cost of extinguishing fires from the delinquents by appealing to their honor, and altogether 96 cases have been settled thus since April 1. There were some 50 cases still pending. Altogether claims in 415 cases have been presented for this spring's fires, 226 of them to railroads, and it is expected that at least half of them

may be settled out of court—a good showing! A tabulated detail statement on 40 pages records all the fires of the year.

We note as singular the absence of any discussion, of installation of observation towers, telephone lines, and other means of preventive character, which no doubt exist, for they appear in the illustrations.

B. E. F.

The Pine Trees of the Rocky Mountain Region. By G. B. Sudworth. Bulletin 460, U. S. Department of Agriculture. Contribution from the Forest Service. Washington, D. C. 1917. Pp. 46.

Since the publication of the author's *Forest Trees of the Pacific Slope,* the trees of the Rocky Mountain region have been similarly described in small handy bulletins, each covering certain genera only. The first one, published in 1915, included the genera Cupressus and Juniperus, and the second took up the genera Picea and Abies.

The present bulletin deals with 14 pines. Its style of treatment is uniform with that of the preceding issues, giving for each species the early history of its discovery and nomenclature, distinguishing characteristics, and facts of its occurrence, habits, and other biological data. The text is largely free from technical terms. The bulletin is profusely illustrated with 28 plates, these being useful line drawings of photographs. The geographical distribution is shown in color, using separate maps for the different species.

J. H. W.

Timber Storage Conditions in the Eastern and Southern States with Reference to Decay Problems. By C. J. Humphrey. Bulletin 510, U. S. Department of Agriculture. Contribution from the Bureau of Plant Industry. Washington, D. C. 1917. Pp. 42.

This bulletin embodies the results of seven months' investigative study of conditions of storage among mills and yards. It opens with a brief discussion for the layman of the causes of decay in timber, giving the life-history of a fungus and how it spreads. It then discusses the methods usually followed in handling and storing timber at the mills and retail yards, pointing out the mistakes practiced in relation to conditions favorable for fungus growth. The location of most mills and storage yards gives moisture conditions very favorable to fungi, and these are generally accompanied by insanitary surroundings.

Improvement can be made by draining the storage yard, making

fills of earth instead of lumber débris, keeping down vegetable growth, burning all rotting débris, keeping tramway structures and "stickers" in sound condition, elevating all piles and piling openly, the author especially favoring concrete foundation piers and treated skids. Outbreaks of fungus disease should be promptly dealt with. The use of sodium fluoride for dipping is recommended as superior to sodium carbonate.

A statement is given of the commoner fungi rotting stored lumber, with illustrations.

The author takes occasion to point out that the lumberman must take more care with his product, especially structural timber, if he is to hold his own in competition with other materials of construction. This bulletin is well suited to help in the education of those engaged in the lumber industry toward improvement of present practices obtaining in lumber yards.

J. H. W.

Forest Club Annual, 1917. College of Forestry, University of Washington. Seattle, Wash. Vol. V. Pp. 95.

Contains, besides matter of interest to the club and college, the following brief articles, of general, more than ephemeral interest: *The Preservative Treatment of Poles,* showing the value of perforating before treatment, and *A Study of Breakage, Defeat, and Waste in Douglas Fir,* showing the breakage in the given case to be 4.7 per cent, defects 6.2 per cent, waste .9 per cent, altogether less than 12 per cent loss; and giving curves showing per cent of total scale of tree represented by the different logs.

PERIODICAL LITERATURE

BOTANY AND ZOOLOGY

Duration of Evergreen Leaves

Perhaps the most extensive investigation on this silviculturally in connection with tolerance, not unimportant subject, has been made by Vinnie A. Pease, in the State of Washington, near Seattle, a moist (36-inch rainfall), and on San Juan Island, a dry station (25-inch rainfall). Washington excels in woody evergreens. Of the 52 species in western Washington, 16 gymnosperms and 36 angiosperms, the author investigated 9 of the former and 22 of the latter, trying to come to conclusions, not only as to the actual facts, but as to causes as far as possible.

In the case of species with covered buds, the scars, marking the boundaries of annual growth, were counted to determine the years, in most case on up to 100 specimens of each species; in case of naked buds, sections through the twigs below the leaves, under hand lens or microscope, served, on up to 50 specimens. On the gymnosperms there were noted the year in which leaf-fall commenced, the year of maximum fall (when twigs were fully half bare), and the extreme duration of the last scattered leaves; these latter sometimes dead or without color. The data were plotted in curves to secure averages.

For determination of causes the series was not complete enough, but a few generalizations the author ventures, which we reprint:

1. Leaf duration varies widely among the different evergreen species, ranging from *Rhamnus purshiana,* which in young plants sometimes holds part of the leaves of one season until those of the next season are mature, to *Taxus brevifolia,* which has an extreme leaf duration of 23 years.

2. Leaf duration varies widely in individuals of the same species of different age or growing in different habitats: (*a*) Saplings have a shorter leaf duration than mature trees in the same habitat. (*b*) Trees or shrubs growing in the open have a shorter leaf duration than those of similar age in the shade. (*c*) Trees or shrubs on a windward coast have a shorter leaf duration than those on a leeward coast. (*d*) Gymnosperms in a moist climate have a shorter leaf duration than those in a drier climate. (*e*) A peat bog habitat has an effect similar to a dry climate.

3. Those factors which cause slowness of growth, and thus only a slight increase in diameter of the axis, are accompanied by an increased duration of the leaves.

4. Under the same climatic conditions, those factors which cause an increase in transportation are accompanied by a decrease in leaf duration, and thus by a decrease in the transpiring surface.

5. Those factors which cause a decrease in photosynthetic activity are accompanied by an increase in leaf duration, and thus by an increase in the photosynthetic area.

6. It is quite possible that the variations in leaf duration in a given species may be due to differences in transpiration or photosynthetic activity, caused by difference in age or habitat.

For our nine conifers and the two evergreen angiosperm trees we brief the details, giving the extremes of shortest and longest duration, and below, the average of duration; in some cases noting difference of statement by other authors; also references to position of trees and pertinent remarks:

Abies grandis. $\frac{2–14}{4–10}$; older trees longer than saplings; shade tends to increase, wind to decrease duration.

Juniperus scopulorum. $\frac{1–4}{2–3}$; if including leaves turned brown, $\frac{3–14}{4–6}$; juvenile foliage shorter duration.

Picea sitchensis. $\frac{2–18}{9–11}$; incomplete observations; peat and marsh situation; trees in ordinary soil not available.

Pinus contorta. $\frac{2–9}{4–6}$; Sargent, 7–8; Sudworth, 6–8; mature trees longest, in contradiction to Sudworth; saplings in open, and mature windswept trees shortest.

Pinus monticola. $\frac{1–6}{3–4}$; mature trees longer than saplings; in peat bogs shortest of any conifer.

Pseudotsuga taxifolia. $\frac{1–16}{3–9}$; Sargent and Sudworth, 8; saplings shorter than mature; open much shorter than in shade; windsweep shortens, dry climate increases; peat bog habitat increases still more, at least in saplings.

Taxus brevifolia. $\frac{2–23}{5–12}$; Sargent, 4–5; Sudworth, 6–9; longer than supposed in densely shady position in dry climate and in ordinary moisture conditions.

Thuya plicata. $\frac{3-12}{4-7}$; duration of green color, $\frac{1-7}{2-5}$; Sargent and Sudworth, 3; mature and shaded longer than saplings or open; dry climate and peat bog longer; browned leaves remain 2–3 years in typical moisture conditions; 4–6 years in bogs.

Tsuga heterophylla. $\frac{2-12}{4-7}$; mature longer than saplings under same conditions; slow-grown shaded saplings under mother trees longer than these; saplings in moist climate longer than in dry; converse for mature; slow-grown bog saplings show two maxima in each of the three curves, the first occurring in the fourth, the second in the sixth and seventh years; variations of toxicity; mature bog trees normal maxima; both longer in ordinary soil.

Rhamnus purshiana. Some leaves persist till May.

Arbutus menziesii. Leaves begin to fall in June of their second year. Second growth in late summer of smaller, lighter-colored leaves makes appearance of two seasons.

Reprint from *American Journal of Botany,* March, 1917, pp. 145-60.

SOIL, WATER, AND CLIMATE

Rainfall Types of United States

Professor R. de C. Ward points out that the distribution of the rainfall during the season is of importance directly and indirectly in agriculture, by furnishing water at the right time and by influencing soil conditions; in irrigation and power works, by influencing size of storage reservoirs and loss by evaporation; in pleasure and health resorts depending on seasonal conditions.

Ward revises the classification of rainfall types in the States by Greeley (6 types) and Henry (10 types).

The basis for differentiating the eight main and various subtypes of the author was found by constructing composite curves, showing the amounts of rainfall from month to month, the composite character being secured by combining the records of five or six stations in the same general district. A small map shows the distribution of the types.

The type which covers the largest extent, namely, practically all the territory east of the hundredth meridian, except the Gulf Coast, is called the Missouri type. This main type covers the northern plain, with variations to the eastward. Its general characteristic, favorable

to agricultural production, is the comparatively dry winter and the main rainfall in late spring and early summer, culminating in June. The type curve rises from slightly above 1 inch in a constant line to June with over 4 inches, then as gradually sinking to 1 inch in December.

Within this type four or five subtypes are segregated; in the territory around the *Upper Lakes* a second maximum in September appears. The *Ohio* type delays the maximum till July, and has considerably wetter winters—more often rain than snow. The New England type is rather difficult to recognize as related to the main Missouri type, for it shows an even precipitation through the year, wavering between 3 and 4 inches; maxima and minima can hardly be spoken of, although a slight maximum may be recognized in August.

The *South Atlantic* type, however, again conforms more to the main type, in that it has a decided maximum in July and August, but additional minima in April and November.

Another peculiar type which it is difficult to range under the Missouri is the *Tennessee* type, with maxima in winter (March) and minimum in October. Here drouths are not infrequent in the autumn. There is danger of the heavy winter and spring rains to cause floods.

The Gulf province is too complex to bring into one type, owing to frequency of thunderstorms and local cyclonic depressions and West Indian hurricanes. The *Florida* type is distinctly tropical, with a rainy season from June to September, a faint secondary maximum in February, and minima in April and November.

The *North Gulf Coast* type curve appears to us to resemble quite closely to the Florida type, but the author compares it to the Tennessee and Atlantic types. The *Texas Coast* type is markedly different from the other coast types, showing a more uniform distribution of rainfall, with a decided maximum in September and a minor one in June, the minimum extending from December to April uniformly.

Toward the Rocky Mountains the Missouri type, which is characteristic of the whole Northern Plains province, experiences modifications into the *Eastern Rocky Mountain Foothills* type, which, with about half the mean annual rainfall, shows its maximum a month earlier, but otherwise conforms to the character of the main type curve.

To the south of this subtype another subtype, the *New Mexican*, is modified from the Missouri type, with a dry winter and a well-marked mid or late summer rainfall maximum (July-August), altogether drier than the main type.

The types of the great *Inter-mountain Plateau* province are of a transitional character. As a whole, the dominant characteristic of the rainfall distribution west of the Rockies is the cold-season maximum. On the plateau we find a combination of the marine rainfall region of the Pacific Coast and the continental region of the interior.

Two well-defined types, one in the north, one in the south, are recognized. The *North Plateau* type shows a winter maximum of only 2 inches, with a secondary maximum in May—a continental feature—and the minimum in July and August. The *South Plateau* type is more complex, most clearly developed in Arizona. The minima occur in the fall and spring, April, May, June, rising then rapidly almost suddenly to a decided maximum in July and August and a secondary one in February. The cold-season rains help winter pastures and snow protects the grass.

The Pacific province is characterized by well-marked winter rains (October or November to March or April), with wholly or nearly rainless summers and large mean annual rainfall. The essential difference between the *North* (from California north) and *South Pacific* type is found in the character of the summer dry season, the North type with significant summer rains, the South practically rainless; the maximum rainfall occurring in January—a rainy season. The Missouri, the Florida, the New Mexican, and the Pacific types exhibit well-marked rainy seasons.

The Geographical Review, August, 1917, pp. 131-44.

Frost in United States

An article intended for use of farmers has also interest for silviculturists, namely, on the growing season for crops in the United States, following up Zon's discussion of the subject, briefed in *Forest Quarterly,* Vol. XIII, p. 89.

Mr. Reed, of the Department of Agriculture, points out that the farmer needs to know, not only the average number of days without frost, but the length of the growing season, depending on frost conditions, and the chances of his maturing a crop, this chance being computed in the same way as insurance risks. Three maps are constructed, the first showing the number of days without killing frosts, where the chance is 4 in 5; the second with a chance of 1 in 10, *i. e.,* if losses from frost occur more frequently than once in five or once in ten years, success in crops is not likely. The third map shows

the probable end of the growing season. The dates are chosen when the chance of safety becomes less than 9 in 10.

Monthly Weather Review, September, 1916.

Hail in United States

According to a compilation and map by A. J. Henry of the frequency of hail in the various regions of the United States, the region of most frequent occurrence is a territory embracing southeastern Wyoming, western Nebraska, Kansas, and Oklahoma, in which four hail storms occur on the average in the year. Adjoining this territory a belt of three storms a year embraces all of South Dakota, the balance of Nebraska and Kansas, the western and central parts of Iowa, and the northwest of Missouri, besides all of Colorado. To the westward a second region of hail frequency is found along the Rockies. East of the Mississippi the annual average is two storms.

In the Pacific Coast States, north to San Francisco, hail occurs from November till March, and hence little damage to crops can occur. Elsewhere hail storms occur in summer, with thunderstorms and tornadoes. One hail insurance company in Iowa is cited as having paid an average of over $77,000 a year for hail losses.

Monthly Weather Review, Vol. 45, 1917, pp. 94-99.

Forest Influence on Hail

On May 16, 1917, an unusually severe hailstorm occasioned great damage over a section of Switzerland, northwest of Lucerne. According to the severity of the damage, four concentric zones could be recognized, which are mapped. The storm coming from the west was interfered with by two other windstorms, namely, a Fœhn from the south and a so-called Biswind from the east-northeast. It is notable that toward the west the zones follow each other more quickly, *i. e.,* the limits lie closer than on the east side. This is explained in that the Biswind was stronger than the west wind, and thus retarded the progress of the hailstorm.

To the question whether forest exercised any protection, Oexlin, the reporter, answers a decided yes: "Wherever forest areas were directly located in the course of the storm the intensity zones were repressed," so that the farms west of the Sedal forest experienced great damage,

while those to the east of it had almost no damage. The same effect was observed in connection with other forest areas.

Ein Beitrag zur Hagelkenntniss. Schweizerische Zeitschrift für Forstwesen, July, August, 1917, pp. 220-222.

SILVICULTURE, PROTECTION, AND EXTENSION

Plantation Margins

A. Murray calls attention to the importance of providing windbreaks on the margins of plantations by choosing appropriate species and treating them appropriately for the purpose, for "wind is the worst enemy of trees in Great Britain" and elsewhere. Species with a tendency of preserving branches, and treatment to encourage such branching, are to be chosen for forming such wind mantles.

In regard to the choice of species, of course, the shallow-rooted ones are excluded. Beech and sycamore are mentioned, meaning probably by the latter designation sycamore maple; oak for its deep-rooting quality and the ability of other species to thrive under it; lime, chestnut, hawthorn, hazel, willows, and silver fir, which all respond well to decapitation, when they will throw out additional branches and form a close hedge. Elder, snowberry, buckthorn, and other bushes may also be used (see *Forest Quarterly,* III, 301).

The Scotch pine is also mentioned, perhaps improperly.

It is generally advisable to plant more openly on the margins and to thin out at the right time to give space for development of side branches, giving up the outer row or rows to the function of protection against wind of the main plantation. Cutting back to secure heavier branching or coppice shoots may also be practised.

The Importance of Plantation Margins. Transactions of the Scottish Arboricultural Society, July, 1917, pp. 156-159.

MENSURATION, FINANCE, AND MANAGEMENT

Pennsylvania State Forestry

Before the Pittsburgh Forestry Conference, Dr. Fernow discussed in detail the financial aspects of the forest policy of Pennsylvania. Basing his calculations on the 1,000,000 acres of waste woodlands which the State has purchased at a cost of $2,250,000, of which 750,000 acres are assumed to need planting up, he shows that with a 4 per cent interest rate and a rotation of

75 years for the white pine, the status of the enterprise in 90 years may be assumed as follows, provided stumpage prices have risen to \$30, *i. e.*, at the rate of $1\frac{1}{2}$ per cent annually:

The purchase price of \$2,250,000 has grown to	\$76,770,000
The annual planting cost of \$80,000 to	64,598,000
The annual administration cost of \$300,000 to	248,400,000
Total expenditures with compound interest	\$389,768,000
The annual incomes from the wooded portion to	\$63,682,000
The periodical incomes from thinnings to	119,500,000
The 15 annual final harvests of \$11,250,000 to	225,000,000
	\$408,182,000

In other words, in 90 years every penny of expenditure, with 4 per cent interest, will have been paid off and a property remains which yields an annual income of \$12,000,000.

If the stumpage price had only advanced to \$20 per thousand, which is the present rate in Europe in ordinary times, so that the final annual cuts were reduced to \$7,500,000, the redemption of all expenditures would only be deferred 8 years, and the property would then be worth around \$200,000,000, figured on its yield.

Assuming that the enterprise is to be financed by bond issues as funds are required and applying incomes to paying of interest charges, it is shown that by the 75 years not very far from \$100,000,000, or \$100 per acre, will have had to be issued. With the 75th year, when the final fellings begin, the income, which is now around \$12,000,000, pays not only the expense and interest on bonds but leaves around \$7,600,000 for redemption of bonds, thus reducing the annual interest requirements, and in about 12 years the whole bond issue, interest and all, will be wiped off the slate.

If we rely upon annual appropriations, leaving out the interest account, but applying incomes to reduction of expenses, by the 75th year \$24,000,000 will have been spent, which the incomes from harvest will have returned in two or three years, leaving a property worth by its income between \$200,000,000 to \$300,000,000.

It is pointed out that 6 to 8 times more acreage than is now in State holdings will eventually have to become State forest, and considering the large financial obligation involved, coöperation of the Federal government with State governments in a comprehensive scheme of reforestation is suggested.

State Forestry. Forest Leaves, August, 1917, pp. 54-58.

Unprofitableness of Waste Land Planting

P. T. Maw records the discouraging production by a Scotch pine plantation in Great Britain lately harvested at about an age of 100 years on better class of waste land: "The results actually achieved under excellent management afford additional evidence, if such were needed, that great schemes of afforestation are doomed to failure so far as any direct monetary profits are concerned." In spite of the exceedingly high prices realized for timber, agricultural use, after spending $20 to $25 per acre for improvement, would have paid better. The plantation comprised 33¾ acres, contained 97,600 cubic feet, not quite 3,000 per acre, and brought around $20,000, or $62 per acre and about 20 cents per cubic foot. The average height was 67 feet, indicating "a little better than quality III." There were only 130 live trees to the acre, or, according to the author, 6 per cent below normal. He then proceeds to show that "the methods advocated by the Germans of growing timber are not based upon sound principles," making the mistake of overcrowding in the latter part of the rotation.

The author makes an unconvincing comparison between Schwappach's yield tables and his own *(Complete Yield Tables for British Woodlands)*, which, however, do not extend to 100 years. As his measurements are made as "super string measure under bark," "super tape measure over bark," "super true contents measure over bark (calculated)," we are somewhat puzzled how to use them in comparison with our or the German measurements, but, according to the author, the volumes would be practically the same, only the average volume per tree varies considerably, namely, 16.5 cubic feet for the German and 36.4 cubic feet for the British tables. The author fails to describe the character of the open-stand timber. He concludes that "the undertaking never paid even 2 cents per acre rent for the land if calculations are made at 4 per cent interest." "There is abundant evidence to show that, in the majority of cases more or less waste lands should be improved for farming purposes, and that if they cannot, with advantage, be so improved, they cannot possibly be afforested at a profit, unless enormously enhanced prices for timber are anticipated, in which case the matter resolves itself into a gigantic gamble."

Forestry Statistics. Quarterly Journal of Forestry, April, 1917, pp. 112-116.

Farming vs. Forestry

The same author quoted above, P. T. Maw, who is responsible for a volume entitled *The Practice of Forestry* and a collection of *Complete Yield Tables for British Woodlands,* gives his experience in managing a 100-acre farm last year and comparing it with forest production. The farm was a poor and mismanaged one, scattered and hence wasting labor, and had not paid expenses the year before. With improved farming, good seed and fertilizers a net profit of $13.70 per acre was secured the first year, and more is expected as this management continues. This result the author compares with an adjoining plantation of Scotch pine, according to the author's yield table on site II. Seven acres of oats had yielded in one season approximately $37 per acre; the Scotch pine adjoining, even with the present abnormal prices, could not at 4 per cent interest have yielded as much as $2. The capital to work the farm was, to be sure, as much as $50 per acre, but the interest earned was 29 per cent.

The author is convinced that the greater part of the waste lands in England and Wales would yield much greater profits by proper farming than by afforestation.

War-time Profits. The Journal of the Board of Agriculture, April, 1917, pp. 63-66.

History of Forest Subdivision

The mistake of basing a forest subdivision upon the accidental and variable conditions of stands instead of some lasting principle has been very frequently made in Switzerland, rendering many changes necessary when the revision of the working plans comes around.

The anonymous author traces the history of the development of forest division in Germany and Switzerland. The first division into simple annual felling areas is reported for the Erfurt city forest in the fourteenth century, and this method became quite general. In France, Colbert introduced the system in 1669, and Frederick the Great around 1740 had all the Prussian forests divided into 70 annual felling areas, probably in imitation of the French practice. A proportional size of areas to take care of varying sites and quality of stands was introduced in 1741 in the Goettingen city forest, and later in some of the Prussian forests. It appears that before this time, around 1669,

the celebrated Sihlwald of Zürich was divided into proportional annual felling areas, based upon an estimate of the final felling budget, without laying the areas out in the forest. For coppice, and coppice under standards, this subdivision might be tenable, but for timber forest it was impracticable.

The fear of a timber famine led to the attempt of securing a sustained yield management by the division or allotment of the entire volume of material over the years or periods of rotation by the so-called volume allotment method. The impracticability of locating the division lines and the general cumbersomeness of the procedure led to the final area subdivision and allotment. The independence of the subdivision from the annual cut was recognized as necessary at the end of the eighteenth century, and led to the square compartment system of equal areas, of suitable size, introduced by Hennert in the Prussian pineries, a method which will probably be permanent, and forms a satisfactory principle in the plains country; questions can, however, arise as to size and shape and location of the division lines with reference to winds, etc. Hartig combated the regularity of form and size of the compartments as of no value, and revived the volume allotment and the idea of making the character of the stand the basis for subdivision, thus introducing again the unstable principles. As to size, he made the requirement that the area should be as much as possible regenerated in one period, *i. e.*, not larger than the periodic area of the normal forest. It remained for Cotta, after the suggestion of Oettelt, to make the area the prominent feature of budget regulation, and the systematic, merely mathematical, area subdivision without reference to annual or periodic felling budgets or character of stand the basis of a permanent subdivision.

He formulates the procedure of subdivision as follows: "As division lines are to be used waters, ravines, roads, as long as these are definitely and properly laid. Differences of stand are not to be considered. Where practicable the compartments are to be given a straight outline and rectangular form, adapting, however, the lines to the topography, for this is permanent, the stands variable. The size of the compartments "depends on the size of the management class" (because, if practicable, it should have the size of a periodic area).

To these earlier masters the subdivision served not only the purpose of orientation and circumspect handling of a forest property, but also as basis for budget regulation.

Those who determined the budget by a normal forest formula had no need of a subdivision in principle, but recognized its usefulness for practical application, in securing the necessary data of stock and increment and in making a felling plan, and the foremost advocate of the formula method, C. Heyer, promoted the practice of subdivision by accentuating the value of permanent character and natural lines, and especially by advising the use of a road system, laid out on the map at least, ahead of all division work. He also introduced the subdivision of the compartment itself according to differences of stand, the unstable features, which are not to remain.

Die Wirtschaftliche Zerlegung einer Betriebsklasse in Abteilungen. Schweizerische Zeitschrift für Forstwesen, July, August, 1917, pp. 189-194.

STATISTICS AND HISTORY

New Zealand Forestry

During the summer, in spite of war conditions, a *New Zealand Forestry League* has been formed to stimulate the government to greater effort in forest conservation. According to the report for 1915 of the State Nurseries and Plantations, a considerable amount of forest planting has been done, and that since 1904, with prison labor, some $200,000 having since then been spent in this way, and altogether $685,000. During 1915 around $150,000 was spent on plantations, two-thirds of the amount being derived from timber sales. A government nursery furnishes plant material at cost, but as this is figured at nearly $10 per thousand, we should expect little use of this "free gift."

The cost of all the State plantations, 27,000 acres, all expenditures included, is figured at over one million dollars, or over $40 per acre, with day-labor wages over $4, and now nearly $5.

As regards exotic species used in planting, the Douglas fir seems to have the best record, while Sitka spruce is a failure, Scotch pine is attacked by aphis, and European larch, which makes remarkable growth, has lately, in middle age become unhealthy, and is gradually declining under the influence of "mysterious forms of premature defoliation."

Quarterly Journal of Forestry, April, 1917, pp. 125-128.

Swiss Forestry and the War

The chief forester of Switzerland, M. Decoppet, gives an interesting insight into the effects of the war on Swiss wood trade and forest utilization. Before the war the forest production of the country was insufficient, and a considerable import, equivalent to one-quarter the home production, was necessary. In 1913 the excess of imports of wood over exports was around 24 million cubic feet. In 1914 the import was still larger than the export by 3 per cent, but in 1915 the relations changed, and the *export* was as large as the import of the previous year in amount and nearly double the import of the same year (1915). In 1916 the export had grown to more than three times the amount of the import and over four times in value. Italy and France took the bulk of all the imports, with Germany third.

This would make the rise in prices over 1914 about 50 per cent, namely, 60 cents per cubic foot. Due to the requisitions for paper pulpwood and to the reduced coal supplies, which forced the gas manufacturers to fall back on wood, prices increased, not only abnormally, but a fuelwood famine was experienced which required government interference and all sorts of remedial measures, such as fixing highest prices; permits for extraordinary fuelwood fellings at times of the year, otherwise prohibited; permission to exceed the felling budgets in public forests, and mutual help in the labor of exploitation. To these regulations were added embargoes on certain exports and permits for other exports; prohibition of the felling of nut trees; surveillance of fellings in private forests; increased fines for nonpermitted deforestation, etc.

In the public forests no overcutting has been done, but in private nonprotection forests many young stands have been sacrificed, and through this inconsiderate exploitation the wood production in the country will be considerably reduced for decades.

The total cut, which in ordinary times is around 2,700,000 m^3, *in* 1916 had run up to over 4,000,000 m^3. To prevent further disaster the limiting prescriptions for private protective forests have been extended to nonprotective forests, and it is hinted that such control may be exercised even after the war. Some suggestions are also made for improving the conditions of exploitation and silviculture, among which increase of public forests.

Allgemeine Orientierung über die Holznutzungen in den Jahren, 1914-1916. Schweizerische Zeitschrift für Forstwesen, July, August, 1917, pp. 214-219.

Forests of France

France is the only country which can boast of having complete statistics of her forests, public and private, in the magnificent official, two-volume publication, *Statistique et atlas des forêts de France,* compiled by L. Daubrée, the director-general of waters and forests, in 1912.

From these volumes Badoux, the editor of the *Journal Forestier Suisse* (which is a French edition, but with partly other contents, of the *Schweizerische Zeitschrift für Forstwesen*), has extracted the following data of interest.

The forests of France, from the administrative point of view, are divided into two categories, those submitted to the *régime forestier,* and those not so submitted. Under the first category belong the public domain and most of the communal forests and forests belonging to public institutions; under the latter fall the privately owned and a few communal and institute forests. This category comprises about twice the area of the first, *i. e.,* fully two-thirds of the forest area is not under government supervision.

The statistical data refer to the year 1908. With an area of 24,-414,000 acres the forest covers 18.7 per cent of the country, or not quite two-thirds of an acre per head. About 5 per cent of this area is unproductive rock, marsh, etc. Apparently there has been an increase in forest since 1892.

The distribution over the country is very unequal, so that there are departments with over 55 per cent, and others as low as 3 to 4 per cent forested.

Ownership is divided in the following proportions: State domain, 12.1 per cent; communal and institute forest under State control, 19.7 per cent; not so controlled, 2.7 per cent; private, 65.5 per cent. In three departments the forest is all private; in ten departments there is no State forest, and in fourteen no communal forest.

During the nineteenth century private forest increased by purchase, while the State was selling until 1870, and by planting, which extended over 2.7 million acres.

As regards composition, 80 per cent are broadleaf, 20 per cent coniferous forest. This explains in part the fact of the large extent of coppice. Only 34 per cent is timber forest, 24.9 per cent simple coppice, 39.4 per cent coppice with standards, and 1.7 per cent in conversion. The largest proportion of timber forest is found in the State's

hands; more than half of the State property, one-third of the communal, and 30 per cent of the private is timber forest, so that more than half of the 34 per cent of timber forest is after all in private ownership.

If the statistics of 1878 were reliable, the timber forest has increased since then considerably. In the domain forests the coppice has been reduced to 2.5 per cent.

The total annual production is given as 237,000,000 cubic feet workwood and 593,000,000 cubic feet fuelwood, or 35.8 cubic feet per acre on the average, a very low figure compared with the German production, and the State forests produce not much better than this average, namely, 38.2 cubic feet, of which not quite 37 per cent is workwood, while the average workwood per cent was not quite 30 per cent. That there are single forests which produce as much as three and four times this budget goes without saying, and the author gives a few examples.

Questions Forestières de France. Journal Forestier Suisse, July, August, 1917, pp. 113-123.

Logging Contracts in India

The existing practice of timber sales in the Indian forest departments is to sell on the stump on a royalty basis. A change is desirable because the government does not secure a fair return in these sales. On the other hand, logging on own account for its drawbacks, hence Parnell develops an arrangement which somewhat resembles our jobbers' contract. The exploitation work, felling conversion and removal of the timber, marked by the forest department, to government sale depots, there to be sold by the department, is to be contracted for a term of years, say not less than five, to responsible firms, which are to employ managers, supervisors approved and in part paid by the department, and, of course, be liable to penalties for illicit, careless felling, and damage, as hitherto.

The financial arrangement is rather novel. The government is to pay the jobbing firm interest at a fixed rate—5 per cent is suggested—on all moneys laid out during the year, and in addition a certain agreed percentage—10 to 12½ per cent is suggested—of the profits from the sale of the timber, if there are any, but in case of loss to bear, say, 10 per cent of such loss. A form of contract and a detailed imaginary cost account under such a system is appended. The system would, of

course, be applicable only in regions where considerable timber sales are possible and promise profitable outcome. There seems some doubt whether any firms, financially responsible, could be found to carry on such jobs, especially when money capital costs at least 9 per cent in India.

A New System of Forest Exploitation. Indian Forester, July, 1917, pp. 297-304.

Meeting of the Society of American Foresters at Pittsburgh, Pa.

Since the last issue of the Journal, a large number of papers have been promised for the Association for the Advancement of Science meeting at Pittsburgh, Pa., December 28, 1917, to January 2, 1918, and so much interest has been shown that it has been decided to hold a separate meeting of the Society of American Foresters at that time in conjunction with the regular Association meeting. The exact date will be given in the next issue of the Journal. Members are urged to submit papers and to send their titles to the Secretary of the Society, Atlantic Building, Washington, D. C. The general treatment of the subject and length of the paper should be indicated, in order that the program may be definitely arranged.

At the New York meeting of the Association last year a very successful meeting of the Society was held, and it is hoped that the meeting this year at Pittsburgh will prove equally successful and receive the whole-hearted support of the membership of the Society.

The annual business meeting of the Society will also be held at the same time, and annual reports of the various officers will be presented.

NOTES AND COMMENTS

"Minnesota Experiment"

It would be of interest to the profession in general to know of the success or lack of success and causes for either of the so-called "Minnesota Experiment" of brush disposal and natural regeneration by seed-tree method in the Cass Lake National Forest.

The system was inaugurated in 1903, when the pine on the former Indian reservation was sold by the Government under the provision that 5 per cent of the stand was to be left for seed trees, which percentage was increased to 10 per cent in 1908.

We commented favorably on the proposition in *Forestry Quarterly*, Vol. III, pp. 105-113. Private information reaches us to the effect that, as was to be expected, the system worked both successfully and unsuccessfully according to conditions. "Wherever the cutting has worked in conjunction with nature—that is, during the proper seed years—it has been very successful. However, the cutting occurred every year, and good seed years occur only, say, every four to six years, and during the intervening years the brush, grass, and other ground cover grows up luxuriantly. The litter accumulates, and by the time the trees produce seed there is such an abundance of ground cover that it precludes all chance of the seed reaching the mineral soil and germinating.

"Hence there are areas that have been restocked satisfactorily; but there are other places where the statutory law has compelled cutting against the wish and desire of every Forest officer, and undoubtedly the opposite of good silvicultural practice, and those areas are still in an unforested condition."

While the seed-tree method has not proved entirely successful on the Minnesota National Forest, it should not be condemned. There is no doubt but what it would prove satisfactory if properly applied.

More About Sites

In the last number of the Proceedings of the Society of American Foresters a note on "What About Sites?" (page 441) mentioned the need of further field studies to determine whether or not we really have the equivalents of Sites IV and V in this country. The note also stated that "conditions in Saratoga County, New York, and adjacent portions of the upper Hudson and Mohawk sand plains show white pine growing on sites which would certainly be classified as IV or V in Europe."

The measurements of sample plots on which this statement was based are given below and show the statement to be well founded. The basis of comparison for the site classification is the height as given in the yield tables of Sites I, II, and III, tables 3 to 5, in Bulletin 13, U. S. Dept. of Agriculture, "White Pine Under Forest Management." The results show three of the fifteen major plots as having a height below that given for Site III. They are listed as "Sub III." The departure from normal for Site III may be gauged by comparing the heights and basal areas of these three plots with the values given for Site III.

Site III.—Age, 35; height, 36 feet; basal area, 167 square feet; vol. = 3,100 cubic feet per acre.

Plot II.—Age, 35; height, 33.5 feet; basal area, 149 square feet; ∴ = Sub III.

Site III.—Age, 50; height, 54 feet; basal area, 204 square feet; vol. = 5,200 cubic feet per acre.

Plot 3.—Age, 50; height, 49 feet; basal area, 106 square feet; ∴ = Sub III.

Plot 6.—Age, 49; height, 48.5 feet; basal area, 134 square feet; ∴ = Sub III.

Development of White Pine on Luther Preserve, Saratoga County, New York, Based on Sample Plots

[Measured during Cornell Forestry Camp, 1916]

Plot No.	Age (years).	Height (ft.)	D. b. h. average tree (inches).	Number of trees per acre.	Volume average tree (cubic ft.).	Volume per acre (cubic feet).	Basal area, per acre, sq. feet.	Site quality (based on height, U. S. D. A., Bul. 13).
	*		(base)					
....	11	10.5	2.6	3,000	......	....	.....	I
....	13	10.5	2.2	1,840	......	....	.....	II
....	14	10.0	2.4	2,760	......	....	.....	III
....	15	10.0	2.5	3,040	......	....	.....	III
10......	30	40.3	6.5	600	4.72	2,830	136	I/II
14......	32	39.5	5.2	630	2.94	1,851	91	II
17......	32	38.0	6.7	610	4.37	2,661	149	II
16......	33	36.8	5.9	620	3.91	2,421	117	II/III
9......	33	36.7	6.3	635	4.76	3,020	137	II/III
15......	34	41.0	6.8	660	5.38	3,550	166	II/III
18......	35	38.8	6.5	650	3.69	2,370	149	II/III
11......	35	33.5	6.6	660	4.30	2,840	157	Sub III
12......	37	47.0	7.3	380	6.28	2,385	111	II
4......	47	50.0	7.5	372	7.02	2,610	116	III
6......	49	48.5	6.6	565	6.06	3,424	134	Sub III
3......	50	49.0	7.5	344	6.85	2,356	106	Sub III
2......	50	67.0	10.3	194	......	[1](17,605)	112	II
1......	52	64.0	11.4	121	......	[1](15,620)	85.3	II
5......	53	55.0	8.6	380	10.70	4,066	153	III

[1] Board feet.

A. B. RECKNAGEL.

Rot in Structures

There has been much agitation in recent years in New England in regard to the use of wood in factory construction. For many years southern yellow pine was extensively used in "slow-burning construction," but recently, because of the many failures of structures, owing to the unsuitable character of timber furnished, wood fell into disfavor. Much to the detriment of the lumber industry, the impression was created that suitable wood for factory construction was no longer available.

Fred J. Hoxie, Insurance Engineer and Special Inspector with the Inspection Department of the New England Factory Mutual Insurance Company, started an investigation a few years ago to determine the facts in the case, with the result, as recently announced, that the main trouble was due not to scarcity of suitable material, but rather to inferior material furnished. In this connection a recent statement of Mr. Hoxie is of interest:

"Within the last five years I have known of 58 serious cases of rot in mill timber, not including 30 or 40 fire-doors. Of these cases, 32 were roofs of buildings with high humidities, 13 were floors over basements with high humidities, five of the most spectacular cases were caused by new lumber of poor quality deeply infected with living fungus when put into the mill, four were from water constantly dripping on good timber, and four were rot which had occurred several years previous to the time of discovery, and doubtless was caused by fungus brought in the new lumber; but the drying of the building had killed the fungus and stopped the rot.

"In every case the damage was preventable. The preventative methods to be used would vary somewhat with conditions. In many cases a better grade of lumber would not have rotted; in other cases where there was more moisture chemically treated lumber would have been necessary. In other cases a slight increase in the temperature would have been the most practicable remedy, as this would have kept the lumber above the dew point and thereby prevented rotting. A water-proof covering over beams which were rotted by water dripping on them would prove efficient.

"Three varieties of fungi are responsible for by far the greater part of rotting roofs, and of these the *Lenzites separia* is most frequently found in roof plank. This is also occasionally found in basements; but another of the roof-rotting fungi, the *Trametes serialis,* is more frequently found in basements. The *Merulius lachrymans, Coniophora,*

and *Fomes roseus* are the basement rotting fungi. These are occasionally found above the basement in new timber which has been recently brought in from the lumber yard. Most of these fungi are killed at moderately high temperatures; therefore they may be destroyed in a new building by heating it several times for a day or two to 115° F. This treatment will have no value with the roof-rotting fungi which thrive at higher temperatures.

"A moderate amount of heat, however, if continuously applied is of value in preventing the growth of any variety of fungus by keeping the lumber well below the dew point, so that it cannot absorb enough water from the air for the requirements of the fungus. This result can be obtained in roofs by increasing the heat insulation, so that the escape of heat is sufficiently retarded to keep the temperature of the wood below the dew point. A double roof is advisable to prevent the planks from rotting in the center, the outer planking being thoroughly creosoted and separated from the inner by mopped, tarred paper.

"An air space has been frequently used to increase the heat insulation. This is worse than useless for preventing rot in highly humidified buildings, as the moisture passes through the wood and condenses in the cooler air space, causing rapid rotting.

"The escape of heat through the glass windows of saw-tooth and monitor roofs is an important factor, the rotting frequently being limited to the neighborhood of windows or skylights, where the temperature is slightly reduced and the relative humidity increased to the dew point. The cure in this case is to put sufficient additional heating pipes near the windows to compensate for the heat lost through the glass.

"Relative humidity is the basis of all timber grading. If this fact be accepted by lumber dealers, it will place timber on the same exact scientific basis as steel or concrete. Timber must be graded according to the uses to which it is to be put; where it is exposed to humid atmospheres it must be the best that our forests produce, and in other more normal conditions nearly any sort of wood may last forever.

"The distinction between relative humidity and absolute humidity should be clearly understood. When the term humid or humidity is used in every-day talk, relative humidity is meant, not absolute. Relative humidity is the percentage of complete saturation that the air happens to contain at the given time and changes with the temperature, while the absolute quantity of water per cubic foot of air remains unchanged. The presence of a cold-water pipe may increase the relative humidity of the air near it simply by lowering its temperature, while the number of grains of water in each cubic foot of air remains almost

unchanged. The presence of a steam-pipe running along a mill roof would have exactly the opposite effect. This would raise the temperature of the air and hence lower the relative humidity, thus preventing condensation on the roof in its vicinity simply because the air would not reach the dew point."

R. C. B.

A New Record of Growth of Pacific Coast Douglas Fir

About a year ago in the *Proceedings*[1] there was an account of some Douglas fir sample plots in the Pacific Northwest which had been growing at the rate of 1,259 board feet per acre per year. Those plots were located on the lower western foothills of the Cascade Range in Oregon. Recently some plots, located on the west side of the Coast Range in Oregon, Siuslaw National Forest, a region of supposedly more rapid growth, have been remeasured and they show an even more rapid rate of growth.

These two plots (each a half acre in area), when fifty years old, averaged in 1911 32,680 board feet per acre in trees 12 inches and over in diameter gross scale, or 9,216 cubic feet per acre in all the trees. In 1916, when they were remeasured, there were 41,451 board feet per acre, or 10,560 cubic feet. That indicated an average annual growth per acre of 1,754 board feet, or 269 cubic feet. Most of the trees had grown about an inch and a third in diameter in the five years; one of them had grown 3 inches. The average number of living Douglas-fir trees per acre had dropped from 291 to 266, because of the death of some suppressed trees; of this latter number 128 were over 12 inches in diameter.

This is a record which, so far as the writer knows, has not been equaled in any other natural coniferous forest in the world where the same intensity of utilization is assumed.

Slash Disposal Experiments in Canada

Specific experiments in slash disposal on the Western Forest Reserves have been so successful that the Dominion Forestry Branch has decided to continue this work and, by means of investigations on larger areas and areas of varied conditions in timber, soil, etc., to develop a policy which will render Canadian forests as free from fire danger, due

[1] Five Years' Growth on Douglas Fir Sample Plots, by Thornton T. Munger, *Proceedings of the Society of American Foresters,* Vol. X, No. 4.

to the leaving of slash, as European forests are generally considered to be.

The experiments were first conducted under the easiest conditions, namely, in jack-pine timber, on small tracts, in somewhat open and even-aged stands without heavy brush, and on sandy land where the fire could not run easily. The brush was piled while the operation went on and burned later. Spruce forest was chosen for the next experiment, and here also results were satisfactory, even though the litter customary on the forest floor of such forests would seem to offer a dangerous possibility for fire getting beyond control in the burning process. At the outset, caution dictated that the piling of the brush be done by the operators and the burning by the forest rangers. Subsequently, however, both piling and burning were given into the hands of the operators, and it was found that burning immediately after the trees had been cut gave the most satisfaction and proved the safest method.

The cost of this slash disposal varied from 25 to 75 cents per thousand feet board measure, according to the efficiency of the operators after some experience, their spirit of willingness or unwillingness to adopt this new method appearing greatly to influence their efficiency; that is to say, the higher cost was maintained for work done by operators who contended that the experiment would not work, while the lower cost was the result where workers started in with the idea that the work would be done well and quickly.

Not the least of the benefits derived from these experiments is the admission by a majority of the operators that this is the proper method of handling slash to insure protection against fire, some also adding that having the brush out of the way facilitates further operations to such an extent that they regard the cost of its removal as practically nil.

Pit Props from Newfoundland

The need of pit props in Great Britain has drawn attention to Newfoundland's timber resources and to a development of a mine timber trade with that colony. Again the announcement that to relieve the shortage in newsprint paper in the States the Harmsworth's Anglo-Newfoundland Development Company has offered to ship its output largely to the States has also called attention to the forest resources of the colony, and especially to the operations of the Anglo-Newfoundland Development Company.

It is claimed that of the 42,734 square miles, which the colony repre-

sents, around one-quarter is timbered; the heavier timber is found along the Exploits, Gander, and Humber rivers. The white pine is practically cut out, so that spruce is the leading timber. As far as we are informed, the timbering is very unevenly developed over the various regions of the country.

The Anglo-Newfoundland Development Company controls over 3,400 square miles, one-third of the reputed timber area, Grand Falls, on the Exploits River, being the center of operations. The mills were finished in 1909, and are turning out nearly 200 tons of newsprint, besides nearly the same amount of sulphite. The investment was over eight million dollars. Some 80 camps and 1,500 hands are engaged in the logging operations, and the pay-roll on the whole enterprise runs up to nearly one million dollars. The reporter of these statements, before the Royal Society of Arts, adds the nursery story that in a rotation of 30 to 50 years the forest re-establishes itself, due to the moist climate.

In this connection the statement of J. D. Gilmour, General Logging Superintendent of the Anglo-Newfoundland Development Company, is of interest:

The greater portion of the island bears no timber, partly on account of natural bogs which are found on flat lands and high barrens at elevations of 1,000 feet and over, partly on account of fires which for 400 years have been allowed to make havoc in the natural forest; the population having relied upon the sea for support, indifference to the forest resource was greater than in Canada and in the United States.

At present protection is brought about through associations of limit holders, which, with government assistance, have for the last five years succeeded in keeping at least the railroad fires down by patrol.

The company has also installed lookouts and telephones, and there have been no fires since logging operations were started ten years ago.

Clean cutting of spruce and fir to 5 inches d. b. h. is practiced, and regeneration is said to be "very fine." The timber is black spruce, with some white and red, and fir.

Material progress has been made by the Ontario Forestry Branch in the organization of fire protection work on crown timber lands in that province. There are 15,712 square miles under license to cut timber, from which the province derives a direct revenue of upward of $1,500,000 per annum in normal times. In addition, a fire tax of $6.40 per square mile per year is imposed on license holders. This amount is

largely supplemented by the province, since the fire ranging organization covers very large areas of lands, much of which have been cut over and burned over, but contain a great deal of young forest growth. The total appropriation for all the lines of work with which the Forestry Branch is charged is in the neighborhood of $375,000. The bulk of this goes for fire protection, but provision is made also for nursery and planting work, eradication of the pine-blister disease, etc.

E. J. Zavitz is Provincial Forester, J. H. White, Assistant Provincial Forester, and L. E. Bliss is General Superintendent of fire protection. The province is divided into 34 districts, with a chief ranger in each district. There are 31 sub-chief rangers and 986 rangers. For the most part, the rangers work in pairs and travel by canoe. Some are on railway patrol, while others utilize the various other methods of transportation suitable to the local conditions in each case.

Five automobile trucks with fire-fighting equipment have been provided for districts where roads to the settlers exist. Some 625 miles of old trails and portages have been cleared out and 60 miles of new trails and portages constructed. Of lookout towers, 22 have been built and 19 more are under construction. About 45 miles of telephone line have been erected.

The permit system of regulating settlers' clearing fires is in effect in the clay belt of northern Ontario and is working well.

It will necessarily require time to get the new organization in thoroughly satisfactory running order, but the progress made thus far gives promise of continued improvement. This work was placed under the Forestry Branch only this year and many serious obstacles have had to be overcome. The improvement already made is really notable.

An impressive test of the improved design of fire pump intended for forest fires on which Mr. Harry Johnson, Fire Inspector, Board of Railway Commissioners, has done such valuable work, was made at Ottawa on May 9 before interested spectators.

The factor of portability has bulked largest in Mr. Johnson's experiments and, of course, has been the chief barrier to the use of any of the existing types of pumps for extinguishing fires in the forest. Last year a most practical experiment was tried by the St. Maurice Forest Protective Association at La Tuque, P. Q., where one of the pumps did splendid service and saved its cost on the single occasion.

This year's design couples the engine and pump direct, the carburetor has been made more get-at-able, and the general efficiency of the

engine improved. The test was conducted by placing the pump 5 feet above the level of the Ottawa River and running 1,500 feet of hose on an 82-foot rise to a point beneath the Sparks Street bridge. With such severe friction as was offered by the length of hose and with the handicap of the rise, the engine delivered 20 imperial gallons a minute at the nozzle, throwing a stream that approximated 30 to 40 feet. The engine and pump weigh 132 pounds and are being adopted in considerable numbers by the Ontario forest service and by private associations in Quebec.—*Canadian Forestry Journal,* May, 1917.

Water alforjas have been used in the fire-protection work of the Forest Service successfully last season on the National Forests in Utah, and will be used this season in Oregon and Washington. They consist of a pair of water-proof panniers, or saddle-bags, holding about 21 gallons of water, and are transported on horseback. Any ordinary pack-saddle, or in emergencies a riding saddle, may be used.

Alforjas have been very useful in putting out glowing embers, extinguishing fire in down timber, applying water directly to small fires, and putting out burning snags. They are also convenient for supplying drinking water to fire crews. A hand-pump is used with the alforjas, which throws a stream about 30 feet.

The water is taken from the top of the alforjas to prevent leakage and from both sides at once, thus keeping the load properly balanced on the pack-horse.

A convenient utensil outfit for a two-man emergency party in fire patrol work has been devised by W. B. Osborne, in charge of the lookout stations of the U. S. Forest Service in the Portland district. This outfit has been planned to be used in connection with an emergency ration, the entire pack being ready to be picked up at a moment's notice. The utensils include a frying pan, three other pans, and two sets of knives, forks, spoons, and cups, and nest closely together, the total dimensions being 8 by 5¼ by 4½ inches. This equipment will fill a long-needed want.

A new scheme in forest protection from fire is now being worked out by the Maine Forestry Department by making panoramic maps of each of the fire lookout stations' area, showing all the configurations of the land, hills, levels, woods and cleared lands, buildings, landmarks, streams, lakes, and rivers. Such a map will lend itself to more ready

location of fires. The telephone system will be the next aid in the work of fire protection in the State.

The forest-fire law prepared by the California lumber and timber interests, and following closely the provisions of the Oregon forest-fire law, which provides for compulsory patrol and which was passed by the California legislature, died by the pocket veto route.

The Laurentian Forest Protective Association was added to the protective association of Quebec this summer, some 15,000 square miles in the Lake John and Saguenay district being involved, including the greater portion of the Laurentides Park. There are now altogether 70,000 square miles under such protection. The provincial government is a partner to the arrangement, which involves a large area of licensed and unlicensed lands.

Farm Bulletin No. 4, published by the Trade Extension Department of the National Lumber Manufacturers' Association, deals with hog houses, portable and permanent. It is, of course, a *bona fide* advertising scheme. In commenting on the use of wood in general, the following reasons for the use of wood are given: Wood remains the most universal, most adaptable building material in the world. The supply is ample for all requirements, and the kinds and grades best suited for all purposes are obtainable everywhere. In cost it remains one of the cheapest materials. It is the lightest building material known and the strongest, weight for weight. Its qualities are known; it is easy to work; it can be cut and shaped by any one into the myriad uses required for the shelter and comfort of man. There is no material more beautiful in appearance, more susceptible to artistic finish, nor which is as productive of sentiment and satisfaction for home building. Wood is a non-conductor of heat—cool in summer and warm in winter.

Mr. R. O. Sweezey, in the *Canadian Forestry Journal* (June), correcting the false impression regarding the development of black spruce, states that though black spruce does grow as "a small and straggling tree" on "semi-barren hill-tops and swamps," there are also thousands of square miles of black-spruce forests running anywhere from 4 to 40 cords per acre. In the clay belt and flat lands of northern Ontario and Quebec probably 60 to 75 per cent of the spruce is black spruce—a vast

quantity, considering that there must be more than two hundred million cords of pulpwood in that region.

The black spruce is of course smaller than the white spruce, but the mature trees in the average black-spruce swamp attain a height of 60 to 75 feet, giving 40 to 70 feet of timber, measuring 9 to 13 inches at butt and 4 inches at top. In the virgin forests of the north as many as 500 to 600 black-spruce trees (of 7 inches to 14 inches in diameter) per acre have been counted.

Regarding the red spruce, Mr. Buttrick refers to it as the "épinette rouge" of the French Canadian. Now, strange to say, the French Canadians, when they speak of "épinette rouge" do not mean red spruce, but they have reference to tamarack. Épinette rouge is known as far north as the James Bay region, hundreds of miles out of the red-spruce localities. "Épinette rouge sec," or dry tamarack, furnishes the best camp-fire fuel of the north country.

Experiments will be conducted on the Lolo Forest in the storage of stock to check advanced growth on late sites, and a small amount of spruce will be sown on the same Forest on sheep bedding grounds, to test the possibilities of obtaining a stand by seeding on burned forest lands now being grazed. Spruce is the only species offering encouragement for seeding in District 1, since the seed is not subject to rodent damage because of its small size.

Mr. W. G. Reed, of the Office of Farm Management, U. S. Department of Agriculture, gives in two articles—"The Probable Growing Season," *Monthly Weather Review*, September, 1916, and "Weather as a Business Risk in Farming," *Geographical Review*, July, 1916—information of interest to silviculturists. Three maps have also been constructed, showing (1) the number of days without killing frost, for which the chance is about 4 in 5, (2) the dates on which the chance of killing frost falls to 1 in 10, or when the chance that there will be no later spring frost becomes 9 in 10, and (3) the probable end of the growing season.

The *Journal of the New York Botanical Garden* for April lists as hardy in the garden 10 pines, namely, *Pinus rigida, sabiniana, strobus* with var. *fastigiata* and *brevifolia, silvestris* with var. *argentea* and *fastigiata, thunbergii, virginiana;* 5 Cedrus, namely, *atlantica* with var. *aurea* and *glauca, deodara, libani;* 3 Larix, namely, *larix, laricina,*

leptolepis; Pseudolarix kœmpferi; and 24 Picea, namely, *abies* with var. *aurea, barryi, compacta, conica, conica densa, finedonensis, gregoryana, inversa, maxwellii, pendula, pyramidalis; bicolor; canadensis* with var. *cœrulea, nana; Engelmanni* with var. *glauca; mariana* var. *doumetii; maximowiczii; obovata; omorika; orientalis; polita.*

A total of 1,350,000 trees was planted last spring on the Cabinet, Pend Oreille, St. Joe, and Lolo Forests, covering about 1,850 acres. The stock was largely yellow pine, because of the difficulty of getting onto sites suitable for white pine, due to the deep snow on northerly exposures.

The office of Forest Pathology has for a number of years experimented in producing a *chestnut proof against the chestnut blight,* taking advantage of the knowledge that our native chinquapin and the Japanese and Chinese chestnut have shown considerable resistance to the disease. The second generation from seeds of these hybrids has appeared quite as good as the parents. Four generations of cross-bred Japanese chestnuts, producing nuts when two or three years old, have already been grown, and the varietal characters appear to be well fixed. These hybrids are probably useful only for fruit production, but the Chinese chestnuts, which in their native habitat reach a height of 100 feet, may, perhaps, be used for forest purposes.

A recent Norwegian consular report deals with the future markets for Norwegian lumber in South Africa. Formerly the lumber shipped to that region was sold through London agents, but within recent years Scandinavian firms have had their representatives in South Africa, who deal directly with the lumber manufacturers. The exports have fallen off very markedly during the last few years, but it is proposed to conduct an energetic campaign for increased sales in South Africa as soon as shipping conditions become favorable. The report gives a list of the sizes most commonly imported. It is stated that 40 per cent of South African lumber imports are consumed in the Cape Province, 40 per cent in Natal, and 20 per cent in the Transvaal.

Two billion feet of lumber in the next twelve months for purposes directly connected with the war is the estimate given by the lumber committee of the Advisory Commission of the Council of National

Defense. The committee adds: "Actually this will not exceed 5 per cent of one year's lumber production of this country." Some of the war-time uses to which this lumber will be put are: buildings at training camps for Army and Navy and for aviation schools, Y. M. C. A. buildings at camps; furnishings, such as cots, tent poles, docks, piers, trench lining, automobiles, saddles, gunstocks, packing boxes and crates, tools, railroad construction work and shipbuilding. The special committee representing the Southern Pine Association, and acting for the Southern Pine Emergency Bureau, announces that "an order for 100 ships to be sawed by southern mills has been placed by the U. S. Shipping Board Emergency Fleet Corporation, at an average price of $35 per thouand feet at the mills." A large number of the southern mills have signified their willingness to furnish the material.

H. E. Surface, reporting on the possibilities of developing pulpwood resources of Alaska, states the present stand of merchantable timber on the 8 million acres of the Tongass Forest as 70 billion feet, as a conservative figure, all coniferous wood. Taking 20 to 30 feet as the annual growth per year and acre, this alone could support a 1,000-ton newsprint mill. But conditions are otherwise so undeveloped that the investment of many millions of dollars would be involved in establishing such a manufacture.

Among comparatively new uses of wood and its derivatives may be cited paper board for buildings, water-proof paper for shirts, storm-proof paper umbrellas, paper string and twine, chandeliers, lamp brackets and paper lamp-wicks, lamp chimneys, paper furniture, bags and trunks, paper jackets for sausages, a long list of vulcanized fiber-ware, paper window-shades, matting, rugs, and other floor coverings, paper insulators, car wheels, paper boats, as substitute for cotton as wadding in manufacture of explosives, in making dressings for surgical work, paper socks and paper boots, paper sheets, pillow cases and mattresses, in combination with cotton underclothing, sheets, jerseys, and other clothing, in place of clay for modeling, waste paper, photographic films.

The final experiment of the de-inking of paper process, invented by Dr. T. Jesperson, of Neenah, Wisconsin, has proved it to be practical. In an experiment at the Riverside Paper Company's mill the paper ran

through without a hitch at standard high speed (24,000 revolutions an hour). A conservative estimate from authoritative sources states that of the 6,000 tons of newspaper consumed in the United States every day at least 1,500 tons could be retrieved in the larger cities alone without organized effort. It is said that Dr. Jesperson is going immediately into the manufacture of the paper, and that the product may be on the market in a short time.

The water in the copper mines in Butte contains a considerable quantity of copper sulphate. Copper sulphate is a preservative of value, having been used extensively in Europe in the preservation of telephone poles by the Boucherie process. The East Butte Copper Mining Company has bulkheaded one of the old passageways in the mine, making a treating tank. The copper sulphate water has collected in this tank and is used for the preservative. When the mine timbers have become thoroughly seasoned and have been framed, they are lowered into the mine and dumped into this vat, where they are left for several weeks before using. A products engineer recently inspected several timbers on the 800-foot level in this company's mine treated in this manner and found that they were in excellent condition after eight years' service. The untreated timbers in this same location have been renewed twice during the same period.

Experiments are contemplated by the office of products to determine the possibility of securing gum from western larch for the manufacture of Venetian turpentine. The present supply of Venetian turpentine is imported from southern Europe and is secured from European larch. One firm in 1913 imported 25,000 pounds of this material, but this was an unusual importation. The average annual consumption is believed to be in the neighborhood of 8,000 pounds. It is used principally in the manufacture of varnishes, sealing waxes, fly paper, and pharmaceutical preparations.

Many retail lumbermen have been agitating the question of making direct delivery charges to customers instead of placing on the lumber a price which would cover this item. One retailer in Iowa gives the following interesting figures on costs of unloading and delivery, based on their per cent relation to sales: Per cent of sales of lumber and battens, 1.58; posts, 1.80; shingles, 1.41; lath, 0.68; sash and doors, 0.88; moldings, 0.68; paper and roofings, 0.83; clay goods, 3.69; cement

and plaster, 2.73; glass, 1.09; smithing coal, 7.90; ladders, 2.31; bee supplies, 0.75; general average, 2.65. For one year this retailer's costs for town delivery was one-third and unloading two-thirds of the dray-age bills for that year.—*American Lumberman,* April 28, 1917.

The lumber cut of British Columbia for 1916 was 870 million feet compared with 583 million feet in 1915; the output of the coast mills for 1916 was 600 million feet compared with 428 million feet in 1915, and the output of the interior mills for 1916 was 270 million feet compared with 155 million feet in 1915.

Since all wood products cannot be counted strictly as manufactured products, the figures compiled in the postal census made by the Canadian government last year show that the Dominion forests led in the value of the output of purely manufactured goods, timber and lumber showing a value of $123,000,000 and paper and printing $74,000,000; total, $197,000,000, while textiles are valued at $144,000,000, iron and steel products at $119,000,000, leather and its finished products at $71,000,000, and liquors and beverages at $35,000,000.

The value of the paper exported from Canada in 1916 was $23,510,-410 and of pulp and pulpwood $24,210,911, as against $18,452,708 and $15,443,527 respectively in 1915.

Stumpage prices in Switzerland in the spring of 1917 for spruce ran from 20 to 30 cents a cubic foot. White pine ran up to 40 cents. This may be figured equivalent to $25 per thousand feet for the lowest and $45 for the highest figure. Fuelwood has risen in price enormously, especially at the end of winter, namely, $2 to $3 per ster, the price per ster being around $5 in the woods; that means $18 per cord.

According to S. J. Record, the tanners and dyers of the United States use annually about $25,000,000 worth of vegetable tan materials, of which nearly one-third is imported.

Surveyors will be interested in a new instrument, the Ross *meridiograph,* by which in five minutes without any computations the true north can be established in the day time by merely measuring with the transit the altitude of the sun. It is manufacturing in two types, for

$20 and $7.50, respectively, by the Computer Manufacturing Company, 25 California street, San Francisco.

The Pe Ell Logging Company of Pe Ell, Washington, is reported to have found the use of motor trucks of 3½ and 5 ton capacity a very satisfactory method for transporting timber from small and isolated bunches of timber to the mill. Trucks average, both empty and loaded, about ten miles per hour on inferior roads, one truck doing the work of ten teams. The average time for loading a truck is five minutes, and for unloading from two to five minutes.

During the fiscal year 1916, 705,872 acres of National Forest timberlands were estimated and mapped intensively and 1,093,006 extensively. In all, 20,815,798 acres have been mapped by intensive and 47,291,660 by extensive methods. The work of classifying and opening to homestead entry such lands in the National Forests as are chiefly valuable for agriculture is progressing rapidly. Already over 70 million acres have been covered by field examination and the final reports acted upon.

On recommendation of the Secretary of Agriculture and by proclamation of the President lands approximating 50,000 acres have been added to the Whitman National Forest, Oregon. Over 4,000 acres are canceled claims, which carry a total estimated stand of nearly 46,000,000 feet b. m. of timber. Much of the other additional land is privately owned, consisting largely of cut-over timberland, rapidly reproducing timber growth. One portion of the act of Congress authorizing the addition provides especially for the exchange of Government timber for privately owned lands in the Whitman National Forest which may be chiefly valuable for the production of timber or the protection of streamflow. Several applications for exchanges of this character have already been submitted.

By way of stimulating woodlot owners to a better utilization, the State Board of Forestry of Indiana claims that the *fuel value of a cord* (128 cubic feet) of good beech, sugar, or hickory wood equals that of a ton of soft coal. The average price of wood is about half that of coal. In other words, we pay double the price for the luxury of burning coal. This statement leaves out of consideration the labor

of keeping a wood fire going. "That there is enough fuel wood in Indiana forests going to waste to run every heating and cooking stove in the State for a year is a fact not appreciated."

A lawsuit lately entered for damages against a railroad company by the Pennsylvania Department of Forestry is specially interesting, in that an expectancy value, with an assumed rotation of 60 years, is the basis for valuation and that such valuation seems to be accepted in principle. The only contention is as to the interest rate at which the discount is to be made, the department claiming 3 per cent, the railroad company insisting on 5 per cent.

The College of Forestry at the University of Washington, together with the rest of the University, has adopted the "Four-Quarter System," with practically an all-year-round session, in place of the semester system formerly in vogue. In arranging the curriculum a special effort has been made to arrange the work so that a student can absent himself during any quarter and enter at any quarter. Instructors will be expected to absent themselves during one quarter each year.

The system offers three special advantages, as follows: (1) Students can engage in war emergency work of a seasonal nature without any appreciable loss to their university work; (2) Instructors can absent themselves at a time when they will be able to attend other universities; (3) Arrangements can now be made for a more thorough co-operation between the University and the industries that are willing to assist in the practical instruction during short periods. In connection with this, arrangements will be made to apprentice a certain number of students each quarter in such fields as logging engineering, milling, marketing, and wood preservation.

The quarters will run as follows: Autumn, October 1 to the Christmas holidays; winter, January 2 to March 26; spring, April 2 to June 15; summer, June 18 to August 31. With the exception of a full quarter in surveying and mensuration on the new demonstration forest of the school during the summer quarter of the freshman year, the Department of Forestry will not offer any of its regular courses during the summer. However, such students as wish may pursue the required studies in the allied sciences and such electives as are allowed during succeeding summers. All students will be encouraged to spend one quarter in practical work each year. The prospects for the coming

year are for a full quota of freshmen and sophomores, but for very small junior and senior classes.

A court decision has confirmed the title of the University of California in the so-called Whitaker's forest, a splendid body of timber of 320 acres, situated in Tulare County. The stand averages about 25,000 feet per acre, with 80 acres running over twice that amount, and consists of species common to the Sierras, namely, sugar pine, yellow pine, white fur and incense cedar. It also contains a large number of giant sequoia, including many exceptionally fine specimens. The area was willed to the university six years ago, both for experimental purposes and as a park, and has since been in liquidation. The Forestry Division has already started studies on the rate of growth by the permanent sample-plot method.

A one-year course has been inaugurated by the Forest School of the Georgia State College of Agriculture. Its purpose is to supply a short practical training in lumbering, with special emphasis on the engineering aspect of the subject. The course is intended to fit the graduate for woods foreman, yard boss, scaler, cruiser or surveyor, and also for the position of ranger in the Forest Service.

The enrollment of professional forestry students, including freshmen, in the Department of Forestry at Cornell University is 37 this year, as against 110 for the college year 1916-17. The registration for Cornell University as a whole is 3,355 this year, as against 4,746 a year ago.

The board of directors of the Vladivostok Commercial School, at Vladivostok, Siberia, will transform the school into a polytechnical institution with several departments, among which the forestry branch will occupy a prominent place.

In investigating the underground water supply of the Santa Clara Valley, California, the Geological Survey found that in the Morgan Hill area, during the rainy season, the ground water level rises from 10 to as much as 45 feet, or an average of about 19 feet. This rise, it was calculated, corresponds to a storage of about 34,000 acre-feet, sufficient to irrigate the whole area of 15,700 acres if planted to orchard.

The annual summer meeting of the Society for the Protection of New Hampshire Forests was held this year at Dartmouth College, Hanover, N. H., September 4 to 6. Professors Filibert Roth and J. W. Toumey gave addresses.

"The Gum Tree" is a new publication published in the interests of scientific forestry and conservation in Australia. It is the official organ of the Australian Forest League and is published at 57 Swanston street, Melbourne. The first number gives information on Australian forests, the Eucalypts of Victoria, and the Forest League.

The New York State Forestry Association held a successful "Forest Week" at the Lake Placid Club, September 4 to 8, in coöperation with the New York State Conservation Commission and the Cornell and Syracuse Forest Schools. Herbert S. Carpenter, H. R. Bristol, H. D. House, F. F. Moon, R. S. Hosmer, A. B. Recknagel, Geo. D. Pratt, and E. H. Hall gave the principal addresses dealing with forestry.

The American Forestry Association has established an American Forestry Tobacco Fund, with which to supply tobacco and other comforts to members of the forestry regiments and sawmill contingents now or soon to be in France. Contributions are solicited.

Mr. G. C. Piche, Chief of the Forest Service, Province of Quebec, Quebec, Canada, wishes to get into communication with any one who has copies and is willing to dispose of numbers 1, 2, and 3 of Volume IX of the Proceedings of the Society of American Foresters.

PERSONAL

1. *Northeastern United States and Eastern Canada*

V. A. Beede has resigned his position as secretary of the N. Y. State Forestry Association, to join the recently established Timberlands Mutual Fire Insurance Company, at Portsmouth, N. H. R. M. Ross, lately of the Vermont Forest Service, is also working for this company. S. L. de Carteret is treasurer and manager. The president and organizer of the company is W. R. Brown, of Berlin, N. H.

W. W. G. Hastings, supervisor of the Deschutes National Forest, Oregon, has resigned to become Chief Forester of Vermont, under Mr. E. S. Brigham, Commissioner of Agriculture, who under the new law is *ex officio* State Forester.

B. A. Chandler, formerly Assistant State Forester of Vermont, has been appointed Assistant Professor of Forest Utilization in Cornell University. He is at present engaged in a study of the utilization of the Adirondack hardwoods.

Hugh P. Baker, Dean of the N. Y. State College of Forestry at Syracuse University, has entered the Second Officers' Training Camp at Fort Sheridan, Ill. Prof. F. F. Moon will serve as Acting Dean during Dr. Baker's absence.

Dr. S. F. Acree, formerly of the Forest Products Laboratory at Madison, Wis., has joined the N. Y. State College of Forestry at Syracuse University, as head of the Department of Forest Chemistry. Other recent appointments at Syracuse are Dr. C. F. Curtis Riley, in the Department of Forest Zoology; Dr. Allen V. Povah, special lecturer in Forest Mycology; H. L. Henderson, instructor in Forest Utilization; H. C. Bellyea, instructor in Forest Engineering; G. T. Forsaith, instructor in Forest Technology, and Carl J. Drake, instructor in Forest Entomology. Prof. Ernest G. Dudley succeeds R. T. Gheen in the Extension Department.

Shirley Allen is acting as temporary secretary of the N. Y. State Forestry Association, vice V. A. Beede, resigned.

H. O. Cook, of Massachusetts, is a captain in the Second Forestry Regiment.

C. R. Pettis and F. W. Rane have been among those active in recruiting men for the forestry regiments.

Profs. S. N. Spring and John Bentley, Jr., are both teaching in the Yale School of Forestry this autumn, during their periods of annual leave of absence from Cornell. Spring is handling Chapman's courses; Bentley, those of Bryant.

R. C. Bryant took A. B. Recknagel's place during the summer in the Cornell Forestry Camp on the Frank A. Cutting Preserve in the Northern Adirondacks, giving the course in Forest Utilization.

A series of lectures, under the general title, "Wartime Uses of Our Forests," were given this year before the Cornell Summer School by Profs. Filibert Roth, R. C. Bryant, A. B. Recknagel, Miss Eloise Gerry, and Messrs. R. G. Kellogg, John Foley, and V. A. Beede.

The following graduates and students of the Department of Forestry at Cornell are in France as members of the Tenth Engineers (Forest): H. B. Steer, B. S., 1914; M. F., 1915; W. H. Doggett, 1916; F. H. Miller, 1916; E. Frey, 1917; G. S. Kephart, 1917; Edgar Myers, 1917; R. E. Perry, Jr., 1917. The four last named by transfer from the Naval Reserve.

Three Cornell foresters hold commissions as second lieutenants as the result of service in training camps during the summer: G. M. Taylor, M. F., 1917; Howard Tilson, B. S., 1917, and D. C. Thompson, B. S., 1917.

2. *Southern United States*

Hammond Robertson is chief lumber inspector for the Panama Canal, with offices in the Audubon Building, New Orleans.

Mrs. Mabel Beckly Millen, M. F., Cornell, '17, is in charge of the Science Department at Alexander College, Jacksonville, Texas.

Russell T. Gheen is with the Southern Pine Association, New Orleans, La.

Gordon T. Markworth, Yale, '17, has been appointed Second Assistant State Forester of Virginia, in place of W. B. Dunwoody, who resigned to join the army.

J. P. Kinney's new book, "The Development of Forest Law in America," is just off the press of John Wiley & Sons.

Hubbard Hastings and E. W. Colledge, two Biltmore men, are managing important departments of the Florida Wood Products Company, of Jacksonville, Fla.

3. *Central United States*

The Hon. Simon B. Elliott, of Pennsylvania, a veteran worker for the cause of forestry, died after a short illness in June, 1917.

Prof. E. A. Ziegler, Director of the Mont Alto Forest Academy, Pennsylvania, has received a commission as Captain in the Coast Artillery Officers' Reserve Corps, and is serving as instructor in military mapping at Fort Monroe, Va. Prof. J. S. Illick has been appointed Acting Director, and Eugene Deatrick, Ph. D., Cornell, has been appointed Professor of Soils at the Academy.

Frederick Dunlap, Professor of Forestry at the University of Missouri, has been commissioned to assist in recruiting the Second Forestry Regiment for France, having been designated enlisting officer for the State of Missouri.

4. *Northern Rockies*

F. G. Miller is now Director of the Department of Forestry in the University of Idaho, at Moscow, Idaho. He has appointed as an instructor on his staff H. E. Schmelter, a recent Cornell graduate.

R. R. Fenska has been appointed Assistant Professor of Forestry at the University of Montana, Missoula.

5. *Southwest, Including Mexico, Central and South America*

H. M. Curran and M. B. Haman have recently completed an extensive forest exploration trip into the interior of Venezuela and Caraco. One result of this

expedition is a collection of some 640 photographs, now on file in the Yale School of Forestry. Haman is at present in the employ of the Demarara Bauxite Company, Demarara, British Guiana.

A. Botha, M. F., Yale, '17, spent the summer studying forest conditions in the Southwest, prior to his return home to South Africa to engage in forestry work in Pretoria.

6. *Pacific Coast, Including Western Canada*

Alex. W. Dodge has resigned his position as Assistant State Forester of California, to accept one with the Standard Oil Company at San Francisco.

Carl A. Kupfer, in charge of Products in District 5, is on a special detail at the Forest Products Laboratory at Madison, Wisconsin, to engage in work of a national defense nature.

C. H. Shattuck, formerly of the University of Idaho, has been appointed Professor of Forestry in the University of California, in charge of the work in management and in grazing.

M. A. Grainger has been appointed Chief Forester for the Province of British Columbia. Mr. Grainger has been Assistant Forester since the inauguration of the B. C. Forest Service, and Acting Forester during the time of Mr. H. R. MacMillan's world tour as Trade Commissioner for the Dominion of Canada.

7. *Hawaii, the Philippines, and the Orient*

C. S. Judd, as well as being Territorial Forester of Hawaii, is also serving as executive officer of the Board of Commissioners of Agriculture and Forestry.

Roscoe B. Weaver is Assistant Professor of Forest Engineering in the University of the Philippines.

Forman T. McLean is Assistant Professor of Botany in the same institution.

F. L. Chang, Yale Forest School, '15, is teaching forestry in the College of Yale, in China, at Changsha.

E. C. M. Richards has gone to West Persia as a special relief agent under the American Committee on Armenian and Syrian Relief. He will work from Tabrey, near Lake Uramia.

CONTENTS

Vol. XV DECEMBER, 1917 No. 8

JOURNAL OF FORESTRY

OFFICIAL ORGAN OF THE SOCIETY OF AMERICAN FORESTERS

COMBINING THE PROCEEDINGS OF THE SOCIETY AND THE FORESTRY QUARTERLY

PUBLISHED BY THE
SOCIETY OF AMERICAN FORESTERS
AT 930 F STREET N. W.
WASHINGTON, D. C.

Single Copies, 50 Cents Annual Subscription, $3.00

Entered as second-class matter at the postoffice at Washington, D. C
under the act of March 3, 1879

JOURNAL OF FORESTRY

A professional journal devoted to all branches of forestry

EDITED BY THE EDITORIAL BOARD OF
THE SOCIETY OF AMERICAN FORESTERS

The Journal appears eight times a year—monthly with the exception of June, July, August, and September.

The pages of the Journal are open to members and non-members of the Society.

Manuscripts intended for publication should be sent to Prof. B. E. Fernow, at the University of Toronto, Toronto, Canada, or to any member of the Editorial Board.

Missing numbers will be replaced without charge, provided claim is made within thirty days after date of the following issue.

Subscriptions and other business matters may be addressed to the Journal of Forestry, Atlantic Building, 930 F Street N. W., Washington, D. C.

JOURNAL OF FORESTRY

VOL. XV DECEMBER, 1917 No. 8

STATE OWNERSHIP OF FOREST LANDS

BY PHILIP T. COOLIDGE

The purpose of this article is to discuss State ownership of forest lands as a governmental policy.

FOREST RESERVES BY STATES

At the outset a résumé of the various State forest reserves may be useful. Although the terms "forest reserve" and "State forest" seem reasonably clear, it will be found that differences in the purposes for which reserves have been created are responsible for differences of opinion as to just what constitutes a "forest reserve" or a "State forest." It may be argued, for example, that a tract of land held by a State primarily for purposes of recreation and under legal restrictions, forbidding the cutting of timber either in accordance with the principles of scientific forestry or otherwise, is not a "forest reserve," but a park.

In order to view the whole subject clearly, the writer has endeavored to list all areas commonly considered by the public as "forest reserves" or as "State forests." For the essential facts pertaining to these reserves he is indebted to the forestry officials of the various States.

New Hampshire has seventeen State forests, with a total area of 8,350 acres. Three of the reserves, amounting to 898 acres, were acquired by gift prior to 1911. The Crawford Notch Reserve of 5,925 acres was acquired in 1911 at a cost of about $10 per acre. The funds for the purchase of this reserve were secured by the sale of scrip bearing interest at 3½ per cent and maturing in 20 years. Of the other reserves, some were acquired by gift and others by direct purchase. The State Forestry Commission may cut and sell timber from the reserves consistently with the general practice of forestry.

Vermont began acquiring State forests in 1909 and has now a number of tracts, comprising a total of 12,000 acres, including the Mt.

Mansfield tract, just acquired; 3,600 acres have been acquired by gift, the remainder by purchase. The average cost of the land purchased has been about $5 per acre, although the laws authorizing purchase have not limited the cost per acre. The total stand of timber on these forests is approximately fifteen million board feet. Small sales of timber have been made, the proceeds from which are used for forestry purposes under the direction of the State forester.

Massachusetts has acquired forest lands in several ways. First, there are the mountain-top "reservations," as they are designated, which have been purchased at various times since 1898. They were acquired primarily for purposes of recreation. They comprise a total of 10,910 acres. The purchase price averaged $21.16 per acre, this rather high figure being explained in part by the fact that the purchases included buildings on one reservation, the construction of a road on another, and land of special value for recreation, or even for resorts, on all. The cost of the four reservations, other than the two mentioned as having improvements, averaged $13.52 per acre, the lowest rate being $2.91 per acre for one reservation of 815 acres. These reservations are not under the control of the State forester, but are under local commissions of a non-technical nature. Forestry has not been practiced in the management of these reservations, unless the mere removal of fire-killed and other dead timber is called forestry.

Secondly, Massachusetts owns the Metropolitan Park District of Boston, comprising 10,287 acres. It is under the control of the Metropolitan Park Commission, and although the parks are not ordinarily considered "forest reserves," the district is noted because it comprises large areas of forest held by the State for public enjoyment.

Thirdly, under the "Reforestation Act" of 1908, Massachusetts has acquired about 5,000 acres in 127 lots. The purpose of this act is to enable the State to acquire a large number of small areas on which reforestation could be demonstrated. The price per acre to be paid is limited to $5, and the area in any single lot was limited at first to 40 acres, but now, by an amendment passed in 1909, it is limited to 80 acres. The administration of this act is under the State forester.

Fourthly, under the law of 1914, which appropriated for land purchase $18,000 a year for five years, Massachusetts has acquired three State forests, comprising a total of about 8,700 acres, and further purchases are being arranged. This law limits the price to $5 per acre. Purchases of land under this act are made by a commission consisting of the State forester and two others appointed by the Governor. The administration of the areas acquired is placed under the State forester.

The total area of land, chiefly forested and devoted to park or forestry purposes, owned by Massachusetts is therefore about 34,897 acres.

Connecticut has four State forests, with a total area of 2,457 acres. The first land was acquired in 1902 for as low as $1.64 per acre. The price to be paid was at first limited to $2.50 per acre, then $4 per acre, and now $8 per acre. The purchasing and management of the State forests are placed under the State forester.

New York has two large "forest preserves," as they are called, the total acreage being 1,814,550. As long ago as 1883 the State reserved all land in its ownership, and the first report of the Forest Commission, in 1885, stated that 715,267 acres had been reserved by the State. A very large part of this area had reverted to the State for non-payment of taxes, and some of it was land with which the State had never parted. Fifty-four per cent of the preserves is heavily timbered, part of it in virgin condition, 25 per cent is younger forest, 14 per cent is waste (mountain-top or water), and 7 per cent is denuded. Several thousand acres have been reforested.

In 1894 an amendment to the State Constitution provided that the forest-preserve lands should be kept forever as wild forest lands, and that they should not be sold, leased, or exchanged, nor should the timber upon them be sold, removed, or destroyed. There is a strong feeling that this provision should be amended, so as to permit the sale of dead and mature timber, since the reservation of nearly two million acres as a wilderness in New York State benefits only those who have the means to go to the preserves for purposes of recreation. Conservative use of the resources of the preserves administered as permanent, producing forests is the only policy which will make them benefit the whole State, for the people need the timber and the employment which conservative development would yield.

New Jersey has seven forest reserves, with a total area of 13,699 acres. The first was acquired in 1905. The average cost has been $3.35 per acre, the land being in the main heavily cut over or culled. There has also been purchased during the past year an attractive lake, comprising 566 acres, in the hilly portion of the State.

The Palisades Interstate Park in New York and New Jersey comprises 23,000 acres, the first purchases having been made about 1901. This park is not generally considered a forest reserve, but is noted because title is held by an interstate commission for permanent public use and because forestry is practiced in the management of the extensive woodlands included in it.

Pennsylvania has 1,008,140 acres of forest reserves in 57 divisions.

This land is largely denuded and much of it was tax-title land. The first reserves were acquired in 1897. The maximum price to be paid was limited by law to $5 per acre until 1915, when the limit was raised to $10 per acre; but the average cost of the land purchased has been only $2.27. The State employs 150 rangers and foresters on these reserves, largely for purposes of fire protection. Eight thousand acres have been planted. The commissioner of forestry is empowered to make sales of timber and other products consistently with the maintenance of the reserves in permanently productive condition.

Maryland has four State reserves, with a total area of 3,000 acres. Fifty thousand dollars is now being spent in the purchase of additional lands on the watershed of the Patapsco River near Baltimore. Of the 3,000 acres now owned, 2,000 acres were received as gifts. Three of the reserves have little timber, but small sales have been possible. The fourth, which is only ten miles from Baltimore, is well timbered, but is maintained as a State park.

Ohio in 1915 appropriated $10,000 for the purchase and reforestation of State forests. The purchase price was limited by the law to $10 per acre. Arrangements are now being made under this law to secure tracts amounting to 1,730 acres.

Indiana bought 2,000 acres of land for a State forest in 1903 at a cost of $8 per acre. The land was partly woodland and partly worn-out farm land. It is under the administration of the State forester.

Michigan first reserved 34,000 acres of its State lands in 1901. The reserves have been increased at the present time to about 300,000 acres in 52 areas. The annual report for the year ending June 30, 1914, of the Public Domain Commission, in the charge of which the reserves are placed, gave the area of the reserves at that time as 235,246 acres. There is also under the charge of the commission an additional 300,000 acres of land, which have been held in reserve since 1913, although it has not yet been definitely designated as "forest reserve." Both the reserves and the class of land just referred to are almost entirely tax-title lands which have been lumbered and repeatedly burned. The Public Domain Commission is authorized by law to sell dead and down timber.

Wisconsin has 342,910 acres of land in its State forest reserve. The State lands were withdrawn in 1903 for examination by the State Board of Forestry through the State forester, and the lands found suitable for a forest reserve, amounting to 233,365 acres, were permanently reserved in 1903. Since 1903 the reserve has been increased by additional reservation and by gifts, amounting to 24,272 acres, and by

the purchase of 159,004 acres, to its present area of 342,910 acres. The average cost of the land purchased has been $3.45 per acre. The land is partly timbered and partly cut-over. The forest reserve is now under the State Conservation Commission, which has charge also of the State parks. Money derived from the sale of timber is credited to a forest reserve fund, which is used for improvements on the reserve or for the purchase of additional land. Land within the reserve not suitable for forest purposes may be sold, and a total of 74,769 acres of agricultural land had been sold through this provision up to January 1, 1913, and 88,822 acres had been excluded, so as to be sold.

Minnesota has three reserves, amounting roughly to 43,000 acres. Twenty-two thousand acres of this were secured as early as 1892 as a gift from the United States. This early gift, known as Itasca State Park, is reserved as a natural park, and cutting only of dead and injured timber is allowed. In 1904 the United States gave the State for forestry purposes a 20,000-acre tract, now known as the Burntside State Forest. There are no restrictions specified as to the use of this land, and practical measures of forestry are carried on under the supervision of the State forester. The State has purchased small areas of private land, amounting to a total of 3,667 acres, within the tracts presented by the Government, in order to secure complete control over the reserves. The Pillsbury State Forest, of 1,000 acres, was presented to Minnesota by the estate of the late Governor Pillsbury.

South Dakota in 1912 entered into an agreement with the Federal Government whereby the State is to secure a compact body of 60,143 acres of timbered land in exchange for educational grants owned by the State. These educational grants, being in isolated sections of a square mile each, two in each township, had been very difficult to administer economically. The transaction is not yet completed, although the State has assumed control of a portion of the area.

Colorado, under special act of Congress in 1910, purchased 1,600 acres of timber land from the Federal Government at $2.25 per acre. It is used for purposes of experiment and demonstration in forestry by the State Agricultural College, where the State forester is professor of forestry.

California has one reserve of approximately 8,300 acres, known as the California Redwood Park. Of this, 2,500 acres were acquired in 1901 by purchase at a cost of $100 per acre. This purchased area has an average stand per acre of 70 thousand feet board measure of redwood. One thousand eight hundred acres of partially cut-over areas were acquired as gifts. The remainder, some 4,000 acres, has been

added by the United States Government, being the unpatented land in the two townships in which the park is located. As the law and the conditions of the donations require that the reserve be maintained as a natural park for the purpose of preserving a body of redwood trees for the benefit of succeeding generations, none of the area is available for commercial uses.

In summary, therefore, the total area comprised in State forest reserves in the United States, exclusive of the Boston Metropolitan Park District and the Palisades Interstate Park, is approximately 3,443,000 acres.

STATE-OWNED FORESTS NOT INCLUDED IN FOREST RESERVES

In making a review of this kind, it is worth while to note that a number of States own extensive areas of forest land which are not included in permanent reservations, or which are not ordinarily considered forest reserves, or which are under the supervision of State officials other than the forestry officials. Whether or not modification of the status or of the administration of these areas is desirable depends upon the particular circumstances in each case.

Among the Eastern States, *Maine* holds in trust for the townships which were public lands when she became a State in 1820 a total of about 69,000 acres of forest land, which was reserved from sale to afford revenue for educational purposes. These lands are comprised mostly in 1,000-acre lots, one in each township. The scattered location of these lots suggests the possibility of meeting the demand for reserves which would include areas of special value for recreation or scenery, by consolidating the lots through exchange into a single large area or a few large areas, but on account of the purpose for which the lots were reserved it is a question whether any plan which would meet the approval of the people of the State could be devised to change the present status.

Minnesota owns three million acres of forest land. A constitutional amendment, ratified by popular vote in 1913, authorized the legislature to place the administration of these lands under the State forester.

Many of the *public-land States,* like South Dakota, own extensive areas of forest lands granted by the United States for educational or other purposes. These lands are generally in the form of isolated sections one mile square. They might well be consolidated, by exchanges, into compact areas. The area of lands suitable primarily for forest production owned by these States has not been accurately determined

in every case, but description of conditions in a number of the States in which there are large areas gives an idea of the general situation.

Colorado, for example, owns 377,000 acres of land suitable primarily for timber production, and also an area of 6,400 acres at the Fort Lewis Agricultural School (Indian). The 377,000 acres, which consists largely of isolated school sections, might advantageously be consolidated by exchange with the Federal Government, and the areas thus acquired placed under the administration of the State forester.

Montana owns possibly as much as 492,000 acres of forest land.

Oregon owns 500,000 acres of land, the proportion timbered being not yet definitely determined.

In *Washington* the State University has placed the administration of its 100,000 acres of forest land under its professor of forestry, an arrangement which should insure development of the property consistently with the maintenance of its permanent productiveness. Washington owns other forest lands besides those granted to the State University.

Federal and State legislation have already authorized exchanges of land in Montana, Washington, and Idaho, and appropriations for the examination of the land necessary to accomplish equable exchanges and to cover the cost of title transfer have been made at various times since 1912, although the actual transfers have been delayed by legal intricacies.

METHOD OF ACQUISITION OF RESERVES

With this résumé of the ownership in the various States, we may make a general classification of the methods which have been employed in the acquisition of forest reserves by the States.

Since the creation of the first State forest reserve, namely, that in New York in 1883, five methods of acquisition have developed. These are as follows:

(1) Permanent reservation of lands already publicly owned, including both the public lands of the States and lands which had reverted to public ownership through non-payment of taxes.

(2) Exchange of lands with the United States in order to create a compact area which could be easily managed by the State, as in South Dakota.

(3) Gift of lands owned by the United States, as in Minnesota.

(4) Gift by private persons, as in Vermont and New Hampshire.

(5) Purchase through State appropriation or bond issue.

PURPOSES OF STATE FOREST RESERVES

The purposes which State forest reserves are intended to fulfill are primarily as follows:

(1) To preserve for public use and enjoyment areas particularly valuable for recreation.

(2) To protect water supplies from contamination, or from the sedimentation caused by erosion, and to regulate stream-flow.

(3) To produce timber as a State business.

(4) To demonstrate scientific forest management to private owners.

Generally more than one of these purposes is fulfilled by every State reserve.

(1) *Recreation*

The acquisition of forest lands to preserve for public use areas of particular value for purposes of recreation is well exemplified in the Adirondack and Catskill Preserves in New York, the Crawford Notch Reserve in New Hampshire, most of the mountain-top reservations in Massachusetts, the Interstate Park along the Palisades in New York and New Jersey, and the California Redwood Park.

The need of public ownership of areas required for free public enjoyment seems beyond argument, and a State may undoubtedly exercise its pleasure in securing tracts for this purpose. Since our customs of land tenure allow individuals to monopolize property desirable for public use and enjoyment, the public must, at the worst, if it desires such property for general use, pay the penalty for having allowed it to pass from its ownership.

There are in many States places of scenic beauty which should be acquired for public enjoyment as soon as the public purse allows. Recently (October, 1915) the Supreme Court of the United States, in the case of the City of New York *vs.* William Sage, has affirmed the principle that the additional value gained for property under action of eminent domain cannot be taken into account in determination of the compensation to be paid to the owner—an encouraging refutation of the idea that submission to extortionate demands in the acquisition of property for public uses is necessary.

(2) *Protection of Water Supplies*

The acquisition of forest lands to protect water supplies is not clearly exemplified in any particular State, although the need of such protection is one of the arguments most frequently urged as a reason for

public ownership. It is a fact that both municipal water-supply corporations and municipalities themselves have generally found that actual ownership rather than regulation is necessary to prevent contamination of water supplies used for domestic purposes. It has been found that satisfactory policing of the watersheds which supply potable waters can be secured only under direct ownership by the public or private interest which is vitally concerned. The obvious fact has also been found to be true that woodland rather than farm land or pasture affords the most effective safeguard against discoloration of water by eroded soil particles and against contamination by the germs of contagious diseases. It is interesting to note that on lands owned by water-supply corporations, both public and private, intensive and very interesting silvicultural measures have proven practical, because the project of forest production is free of any debit for the value of the land, that value being charged against the primary purpose for which the land is owned, namely, water production. As with lands needed for purposes of recreation, public acquisition of lands actually required to protect waters used for domestic purposes is desirable. In every case, however, the cause of sound democratic government demands that the necessity for the purchases be accurately determined and clearly understood by the body politic.

The admission of erosion and sedimentation alone as an argument for land purchase, however, apart from its bearing upon the need of protecting domestic water supplies, is a different matter. Erosion in itself is no evil except as it depletes the fertility of the soils eroded, and since the soil is valuable only for what it will produce, consideration of this aspect of the problem may be included with that of timber production. Both the clogging of river beds with eroded sediments, resulting in the formation of sand-bars and the destruction of fertile bottom lands by the deposition of sands and gravels, cause serious losses; but projects of forest acquisition and protection are not justified as remedial measures unless they yield benefits commensurate with their cost and are the most efficient means of accomplishing these benefits. Erosion and sedimentation are intimately related to the problem of excessively high and excessively low waters, but reservoirs and similar engineering construction rather than forests have been found under many sorts of conditions to be the effective instruments for stream control. Reservoirs are also essential for increasing the amount of water which flows in streams, and it is important to know that measurements have not indicated that the flow of streams rising in forested areas averages appreciably greater than that of streams rising on cleared lands of

equal area. Again, the fact that forest protection is an effective method of preventing erosion in certain regions, as among steep mountains, does not prove that it is worth its cost for this purpose in other regions. Determination as to whether projects of land purchase will render appreciable benefits to stream conditions, whether these benefits are worth the cost, and whether the perpetuation of the forest cover either by public ownership or in any other way, is the most effective method of gaining the results desired, is requisite for the establishment of public policies that will endure.

(3) *Timber Production*

The ownership of forest lands for timber production is best exemplified by the large reserves in Pennsylvania and Wisconsin, secured by the reservation of tax-title and other lands already owned by the States and by the purchase of extensive tracts at low cost.

To discuss the general proposition of State ownership of forest lands for timber production, let us consider, first, areas already owned by the States. It seems axiomatic that cut-over lands of the type of those in New York, Pennsylvania, and Michigan, which reverted to public ownership for non-payment of taxes as soon as the virgin growth was removed, thus becoming public charges as soon as exploited, should never have been allowed to pass from public ownership. Individual ownership has proven eminently uneconomical and even destructive of the permanent productivity of lands which can be operated only at long intervals. The private owner of land which can be operated only once in a lifetime feels no personal interest in methods intended to maintain permanent productiveness. If a second cut of timber cannot be expected during his lifetime, it is immaterial to him whether or not the land is reduced to a waste by fires or other destructive agencies at any time after he has removed the virgin stand. On the other hand, the possibility of efficient administration for permanent utilization of lands of this kind under public ownership has now been well demonstrated. It is demonstrated by the record of efficiency earned by the Federal Forest Service in the administration of the National Forests—a record which bears testimony to the ability of an American governmental bureau, working under proper laws and in spite of governmental complexity of procedure and political opposition, to administer large areas of public forest land. It is also demonstrated by the administration of the Dominion and Provincial forest lands of Canada, which were retained in public ownership to far greater extent than in the United States. The two principal reasons, by the way, which contributed to

the retention in public ownership of vast areas of Canadian forest are undoubtedly the inhospitality of the region to agricultural settlement and the somewhat more paternalistic nature of the government.

That such lands cannot be unloaded permanently on private owners, Michigan, for example, has learned by the repeated reversion of tracts for non-payment of taxes. Fortunately, from the point of view of the public welfare, the opposition to forest reserves in the Lake States has come primarily from real-estate interests bent on the development for agriculture of lands which have been proven unfit for that purpose by the bitter experience of deluded settlers.

The possibilities in permanent public ownership of forest lands are now generally recognized by the States which own considerable areas of land unsuited to annual operation, and, as has already been noted, there is a general movement in the public-land States of the West to consolidate their lands by exchange with the National Government, so that areas of size sufficient for economical administration by the States will be established.

But whereas the reservation in public ownership of lands unsuitable to annual operation has proven eminently economical and practical, the expenditure of State funds to purchase forest-reserve areas may be a more debatable project. Extravagance in purchasing forest lands would be no less economically wrong than would complete neglect of the State to acquire such lands.

In the first place, erroneous conclusions as to the "inestimable" value of timber supplies, arising from ignorance or incomplete analysis of the facts, are very common. It should be kept in mind that the experience of the European countries which have found public ownership of forests necessary for adequate control applies to tracts important for protection of water resources rather than for timber production. Timber, like any other commodity, is not of "inestimable" value, but is worth just what people are willing to pay for it. Policies designed to insure future supplies should take into account what the natural supply will be and what the demand will be. The extent to which substitutes will be preferred, either on account of their cheapness or their relative adaptability for the purposes for which materials are required, demands particular consideration. It is common knowledge that although there are many uses of wood for which it appears indispensable today, there are many other uses for which substitutes not just as good, but better, have been found.

Statistics indicate that the annual cut of lumber, enormous though it be, is not at present increasing, the highest figure having been reached

in 1909. The use of substitutes has not, to be sure, decreased the annual cut, but it has brought it to a standstill. The future of our timber supplies is indicated in the report upon the lumber industry issued by the Federal Commissioner of Corporations in 1910. In this report it was estimated that at the current rate of cutting our timber supplies would last fifty-five years longer. In other words, our timber supplies are being reduced now at a rate of about 2 per cent a year. Again, investigation by the Federal Forest Service indicates that in the twenty-two years preceding 1908, the average increase in the price of ten important species of lumber at New York was only 3 per cent a year, not a startling increase when it is remembered that commodities of all kinds increased in value during that period. The proximity of these two figures of percentage, 2 per cent and 3 per cent, is a circumstance worthy at least of careful contemplation.

Private owners of forest lands are not ignorant of the facts made public by these reports. Private owners have, furthermore, modified their methods in response to the decrease in timber supplies, or, to be more accurate, in response to the increasing values of timber caused by the decrease in the supplies. Naturally, conservative methods under private ownership have begun in the localities where market conditions render such methods financially correct. Where stumpage prices have reached figures high enough to demand their attention, private owners have eliminated the old-time waste in high stumps and careless skidding, and the most complete utilization practically possible in mill and yard is required. Furthermore, where the trend of stumpage prices warrants, and where conservative methods of lumbering are practical, as in extensive portions of the spruce region of the Northeast and in the second-growth hardwood region of New England and the Middle Atlantic States, attention is given to the protection of young growth and even to the reservation of the smaller merchantable trees for future rather than for present cutting. Where young timber is cut, the demands of the market, not the wantonness of owners, must be held responsible. The exigencies of personal or local conditions, of course, not infrequently necessitates cutting of a kind which the owners realize is wasteful and unprofitable even to themselves; but such cutting is not the rule, and it is by no means a general evil inseparable from private ownership. Not only conservative cutting, but even planting, solely for the production of timber crops, has made its small, but appreciable beginning in the region where growth and market conditions together are most favorable, namely, in the white-pine region of New England.

A moment's thought, then, brings before us the future of our timber

supplies. We can see, all correlated, diminishing supplies of the natural stand of timber, increasing prices of forest products, increasing substitution of cheaper or more satisfactory materials, constantly greater economy in the utilization of timber in all steps of the lumbering operation from the forest to the consumer, more and more care in the protection of growing stands from fire or other destructive agencies, and finally, when prices warrant, the employment of special measures for securing natural or artificial regeneration, beginning and extending from the regions of most rapid growth, easiest protection, and most profitable markets. We can see the future because these processes have clearly been going on during the last few decades.

A timber famine is out of the question, because long before the fifty-five years granted us in 1910 have elapsed the various factors outlined which tend to prolong the duration of our timber supplies will have postponed the evil day so much longer. But just as our timber supplies are being reduced only by a small fraction year by year, so the effort of the nation to renew them likewise needs to increase only gradually. At the worst the problem of future timber supplies is simply a local problem, worthy of consideration only where the cost of freight from the important timber regions of the country exceeds the cost of timber production at home. Even for military needs, unless our military experts advise us to the contrary, the private forest lands as ordinarily managed, together with the National Forests which have been established, assure us of sufficient timber supplies.

There is, then, no economic necessity for State production of timber. The State has, to be sure, two obvious advantages over the private owner, one the fact that it can secure loans at lower rates than the private borrower and the other the fact that in all belief it will live forever. The ability of the State to secure loans at comparatively low rates of interest enables it to undertake projects which would pay insufficient interest to attract capital for private enterprise. The longevity of the State permits it to await with equanimity the maturing of the timber crop, whereas the private owner feels that if he is to realize upon his investment during his own lifetime he will, very probably, become a vender perforce and will have to accept the forced vender's usual lot in a transaction.

On the other hand, allowance must be made for the fact that American governmental organization is relatively less well suited for the conduct of enterprises of production than are private concerns. Public work is generally more costly than private, and the maintenance of efficient and honest administration is less certain. These difficulties are

particularly aggravated in town and country governments. In Massachusetts, for example, the county committees which have had charge of the mountain reservations have ignored the possibility of securing technical assistance gratis from the office of the State forester and have allowed the reservations to be ravaged more than necessary by fire and insects.

Inordinate expenditures by the State for purposes of timber production, then, may be politically ill-advised as well as economically unnecessary. But in projects where the fulfillment of purposes other than timber production is desired, the possibility of deriving some returns from that source may, of course, render the project financially possible. Without such revenue the cost of purchasing and maintaining tracts, needed perhaps primarily for recreation, would involve expenditure beyond the pocketbook of the State. Forest reserves almost always serve more than a single purpose, and the various purposes ought to be considered together as well as separately.

Considered simply as financial projects, however, without regard to the other advantages in public ownership, investments in forest lands should, at best, be made only when they promise to yield the rate of interest usual for public securities, and such investments should be based, as sound business procedure would dictate, upon accurate understanding of the rate of tree growth, the hazards to which the growing stand is exposed, and conservative estimates of the value of forest products at the time the crop will mature.

The wisdom of projects of land purchase varies with the particular circumstances. It would, for example, seem poor business administration for the State to enter the market for land which is coming into its hands anyway, as by abandonment through non-payment of taxes. The entrance of the State into the market as a buyer of such lands would render it exceedingly difficult for State officials to prevent improper inflation of values.

On the other hand, even in regions where land is reverting for taxes, purchases of land by the State are not infrequently advisable as a means of straightening boundaries and eliminating private ownership within State-owned areas. The acquisition of land which thus simplifies administration is frequently proper, since it permits important economies in annual expenses for administration and protection.

Unique problems are presented in regions where extensive areas are kept undeveloped because of speculative mineral value. In such regions general principles are set at nought by local conditions. Even separation of the title to minerals and surface and public ownership of the

latter may not be feasible, for the speculative value of the minerals may give all portions of the surface a milder, but appreciable speculative value, since there is always the possibility that they may be required for the various operations accessory to mining operations. Apparently the enforced idleness of such lands must endure until the true value of the earth's depths becomes known, and protection against fire and other agencies of destruction for the inferior growth which occurs naturally seems to be the only benefit which the State can wisely afford.

Silvical conditions have an important bearing upon the advisability of land purchase by the State. The degree to which public ownership would modify private methods of management must be considered. Keeping in mind the two important advantages which State ownership has over private ownership, namely, the ability of the State to secure loans at low rates of interest and the longevity of the State, it will be seen that in regions of slow-growing, intolerant trees, where, after the expense of establishing reproduction has been incurred, returns are precluded for a long period of years, the advantage of public ownership is great. Where silvical conditions of this kind exist, as on the fire-swept plateaus of Pennsylvania or the sandy plains of Michigan, private ownership will not soon undertake reforestation. On the other hand, where the occurrence of tolerant species, like spruce, or of rapidly growing, easily reproduced species like the sprout hardwoods, makes frequent cutting possible, the long-time element is far less important and the advantage of public ownership is not at all clear. In such regions the private owners are already removing trees only as they reach merchantable size and are reserving the younger trees for future cuts. Satisfactory reproduction already occurs immediately after clean cutting. That the employment of more intensive methods of silviculture or utilization in such regions would yield returns commensurate with the increased cost of operation and administration which such methods necessitate, whether under public or private ownership, has not been demonstrated.

Another point that should be considered is that for small areas the administrative cost per acre is relatively high. Small areas mean relatively long boundaries to maintain, greater proportionate expense for protection and inspection, and greater irregularity in returns and expenditure. The acquisition of forest lands should not be undertaken unless the conditions are such that the State feels that it can become committed to continued appropriations for purchase, protection, and administration. If the areas acquired have been largely denuded, so that they will be unable to yield actual returns for some time, there is

particular need of a definite program. Spasmodic appropriations, or appropriations not based upon a definite program, may prove ultimately to be money thrown away. The obligation of the State to safeguard its resources for the future is not overweighed by its obligation not to waste its energies by misdirection of effort at any time.

In the prosecution of a purchase policy clear-headed valuation of properties considered is particularly necessary. For instance, in regions where cut-over lands are abandoned for taxes, the soil, oddly enough, bears timber of commercial value; but for the business of growing timber it is itself without value, at least to private owners. This is generally because the growth is so slow and the cost of reproducing and protecting stands so great that no surplus is anticipated above the mere operating expenses of growing the stand. This is the "no-rent" land of economics. In many regions the land with the trees on it does not become salable until the latter have reached considerable size. Projects of purchasing land of this character should have the most careful scrutiny.

It must be kept in mind that it is not alone the long period of time involved which teaches caution in undertaking more intensive methods of timber production, but the indeterminable losses which may occur during this long period. The possibilities of loss by fire, insects, or fungi, the unknown quantity of taxation, the possibilities of adverse legislation, changes in market demands, and what not are obstacles which the State as well as the sound business man is bound to consider, and it should not undertake investments in forest production until the returns promise to overbalance the possible losses by a safe margin of profit. Failure to weigh thoroughly the hazards in the business of timber production has been responsible at the same time for mistaken impatience with the conservative attitude of private forest owners toward intensive methods of forestry and for wildcat visions of large public revenue from investments in forest lands.

It is suggested that if purchases of land intended primarily for timber production were made not from appropriations, but from the proceeds of the sales of bonds which were required to derive their interest ultimately, at least, from the operation of the lands acquired, the procedure would have one virtue certainly, namely, financial clarity. Clearness of observation and frankness of statement are the safest guides in determination of a policy of land purchase. There should be accurate understanding by the body politic of the purposes for which the purchase is urged and of the extent of the net revenue or net deficit anticipated.

Let it be borne in mind that the essential function of the State is the protection of life and property. The purpose of the State in respect to timber production, then, should be to establish and maintain conditions which will render it a profitable business whenever supply and demand warrant expectation that it can be made a profitable business. This means primarily protection from destructive natural elements such as fire and insects, and also from artificial handicaps, such as reckless competition among the industries related to forests, bad titles and surveys to land, fraud and speculation in schemes of promotion and development, uncertainty or injustice as to taxation, improper financial methods, and other circumstances which make the business of producing forest products and placing them on the market hazardous and uncertain. In few States has the prime obligation of protection against fire been fulfilled adequately to safeguard even merchantable stands. Protection is generally still insufficient to prevent wide-spread destruction of young stands, particularly subject, as they are, to injury by fire. The private owner feels little inducement to invest in improvements for the growing of timber which is more likely than not to become a prey to the flames. Throughout the sprout hardwood region of southern New England, New York, and New Jersey, where growth and market conditions are particularly favorable to the business of timber production, for at least five years an average of about 2 per cent of the forest area has been burned over annually, thanks to the inadequacy of the appropriations for fire protection. Under such conditions, the purchase of land by a State for purposes of timber production may be a diversion of funds from protection seriously needed for the forests of the State as a whole, and the losses occasioned by the fires may be far greater than the benefits that could arise from the timber produced under State ownership on the limited tracts acquired. State purchase is only a transfer of ownership, and protection must be afforded the land, whether publicly or privately owned. Whatever improvement in fire protection has been effected on publicly owned land has been due to the proportionately larger sums spent for protection rather than to respect arising from the public character of the property.

In the making of forestry appropriations, which as far as possible should be comprised in a budget, the normal protective function of the State should have first consideration. The principal aim of the State forestry office should be to afford consistent, orderly protection to the forests of the whole State, year after year. Projects of land purchase ought to be considered as of secondary importance and should be consummated only in accordance with a sound, carefully thought-out program.

Forest fire protection, furthermore, is pre-eminently a duty of the State and is a duty neither of the local governments nor of the private owner, for fires observe neither property nor township boundary lines. The failure of the towns to afford adequate fire protection in some of the New England States was flagrant, and remained so until the State governments were given effective control as central offices. Fortunately no branch of State forestry work has produced more effective results for the appropriations or has been conducted with greater public spirit than the work of fire protection, and the public ought to feel full confidence that appropriations for this purpose will be wisely administered.

There is still one phase of the problem of State ownership for purposes of timber production which should be discussed, namely, the policy to be pursued where private methods of lumbering appear to jeopardize the permanence of forest growth, especially where conservative treatment, even under efficient public ownership and administration, does not promise normal financial returns. The most essential point to be determined is whether these methods will bring about soil destruction, and will, therefore, render reproduction impossible at any time. Clean cutting in itself is not necessarily an evil. In many regions clean cutting is indeed the method of regeneration adopted by silviculturists. On many types satisfactory reproduction follows clean cutting after the occurrence of one or two seed years—the interval ordinarily allowed in silvicultural operations—and if adequate fire protection is provided a new generation of growing trees is established. Clean cutting is justified, also, if the land can be used subsequently with greater profit for agriculture or grazing. But if soil destruction is threatened, the State, looking forward to the requirements of increasing population, ought to be seriously concerned. This concern is not æsthetic and cannot be measured in dollars and cents, but is rather in the nature of patriotic foresight.

Where soil destruction is really threatened, the necessary changes in lumbering methods often cannot be effected satisfactorily by State regulation or by any scheme short of State ownership. Regulation which involves unexpected and appreciable increases in the cost of logging is likely to cause injustice to the land-owners, and for this reason, if it did not prove to be an actual confiscation of property, and therefore unconstitutional, it would probably be so opposed that enforcement of the law would be difficult and uncertain. Coercive policies cannot survive in a democracy. In Europe it has been found that where radical modifications of lumbering methods are necessary to prevent soil destruction, as on watersheds, regulation is unsatisfactory and public ownership is necessary.

On steep mountain slopes in a glaciated region, as in the Northeast, all the king's horses and all the king's men cannot restore forest conditions after the soil is gone. Only after centuries can the flat-rooted spruce and balsam succeed in re-covering the sloping granites. In this region ordinary lumbering alone, without the aid of fire, not infrequently causes total erosion of the soil. On the other hand, the degree of soil destruction is very often found to be less, upon close examination, than the striking change in the appearance of the land after the cutting of the dense virgin forest would lead one to believe at first glance. For example, in the 10,000,000 or 12,000,000 acres of the spruce region comprised in Maine, modern lumbering methods jeopardize only the steepest mountain slopes, a total area of less than 3 per cent of this region. On all except these occasional very steep slopes abundant reproduction is of general occurrence even after clean cutting, and if adequate fire protection is afforded ordinary lumbering does not effect the permanent productivity of the forest soils. The proportion of forest soils jeopardized by modern methods is, of course, greater in regions more mountainous than Maine; but in many States adequate fire protection for the forests as a whole would afford the necessary protection for the special areas where forest destruction appears to be particularly threatened.

It is conceivable, too, that there are soils which promise so little that it is not worth the attention and energy of the State at the present time to protect them. Obviously some lands will not be developed as soon as others, and the poorer must await the requirements of a larger population. The plea of jeopardy to certain areas may or may not, therefore, be a sound argument for State ownership. Observation must determine two essential facts: first, whether or not the soil destruction is actual and serious, and second, whether or not adequate fire protection for the forests of the State as a whole will provide the necessary safeguard for the areas where soil destruction is particularly threatened.

(4) *Demonstration Tracts*

The acquisition of forest reserves to serve as demonstration areas is particularly exemplified by the small reserves established in Vermont, Connecticut, New Jersey, Maryland, and Indiana, and the lots secured under the reforestation law in Massachusetts.

In determining the proper policy in respect to the establishment of reserves for this purpose, the first question to be considered is whether the State can demonstrate anything which the private owner can imitate. In the northern hardwood region, for example, where conditions render

protection against fires particularly easy, and where the natural forests can be appreciably improved by the planting of conifers, the use of demonstration areas seems wise. The reforestation law in Massachusetts has been effective in demonstrating practical reforestation. The unit of area which could be acquired in any one tract was limited purposely to eighty acres, in order to force a wide distribution of demonstration centers throughout the State. These small plots have been of value in demonstrating to the private land-owner the possibilities of artificial reforestation on certain types of land in Massachusetts, and the private owner has shown himself ready to follow the leadership thus taken by the State. On the other hand, where planting is unnecessary on account of abundance of natural reproduction, or where it is impractical on account of one or more of different reasons, such as its cost, the slowness of tree growth, or the cost of protection, it is frequently impossible to bring about appreciable modification in the management of private lands. Since the usefulness of demonstration areas is limited almost entirely to exemplification of silvicultural methods, the value of these areas is much less clear in States where striking modifications in silvicultural methods are impractical. Improvement in woodlot or small forest management in regions of this kind depends primarily upon the ability of the land-owner or operator to find complete and satisfactory markets for his products. It is, for example, merely theoretical to demonstrate the thinning of defective or weed trees unless there is a market which makes the utilization of such trees financially practical. There may frequently be considerable question, in fact, as to just what species ought to be considered forest weeds. For example, now that certain processes of paper manufacture permit utilization of considerable balsam, that species is looked upon with much more favor than formerly, its growth being faster than that of its associate spruce. On the other hand, the occurrence of the blight in chestnut has caused that species to be relegated in a number of States from a standing among the most favored to one among the least to be desired. It is, of course, scarcely probable that many species will be as disappointing as has chestnut, but the lesson it teaches is the exercise of caution in making prophecies as to future values of trees.

Business caution is just as commendable as speculation. What the woodlot owner wants is sound business advice, and there is no reason why he should alter his methods in the woods except in accordance with the dictates of sound business. The advantages in new methods like "improvement thinnings" should be established by thorough scientific investigation, and least of all should changes be urged in order to

secure conformity with theoretical methods colored with a semblance of art or patriotism. Trees which at present promise apparently slight returns frequently cost little to hold and much to get rid of, and the general upward trend in the values of forest products usually renders holding such trees the wisest policy, provided, of course, that they have sufficient vigor and soundness to promise values at the next cutting equal at least to present values with interest.

Furthermore, the relative high cost of intensive thinnings must be kept in mind. This cost is high, partly on account of the expense in time and possibly in special technical services necessary to determine and indicate on the ground which trees are to be cut, partly on account of the care required in logging, and partly on account of the relatively smaller quantity of timber handled. Operations conducted on State-owned lands necessitate overhead charges for supervision which may be justified from the point of view of scientific experiment, but would be money wasted in ordinary private operations.

Again, unless the silvicultural operations which can be conducted on demonstration areas are sufficiently striking, it is frequently to be doubted whether the ordinary owner will be able to detect the nature of the operation.

The same funds which are spent in land purchase and administration for demonstration purposes can frequently be made far more effective by scientific studies as to growth, timber values, markets, etc., and by co-operation with the private owner for the purpose of enabling him to find the right markets at the right time for the various kinds of timber in his woodlot. Even within small States market conditions vary in an astonishing way, and the active accomplishments of the State officials in keeping posted and in advising owners and operators is far more comprehensive and valuable to them than are demonstrations, practical imitation of which is dependent not upon an understanding of the silvicultural operations exemplified, but upon market conditions.

The opportunity for investigation in forestry matters in America is enormous and affords a splendid field for constructive work. This field comprises not only studies in the woods, as of growth and timber supplies, but studies of those artificial conditions, such as markets and taxation, which have important influence upon the business of timber production. Every possibility of improper business methods, whether careless merely or fraudulent, increases the necessity for handling property in a speculative, short-sighted way, and is a deterrent to conservative management. The State forestry office should have sufficient

knowledge of timber values to protect the honest investor from the promoter of fraudulent, speculative schemes, and in general should be able to give stability to the entire lumber industry within the State. The technical knowledge of the various State forest administrations may sooner or later be called upon to assist in reaching fair solutions of problems relating to combinations for marketing forest products which may possibly contravene the wording, if not the spirit, of existing anti-trust laws. The State may sometime indeed assume direct charge of the marketing, advantageously to all concerned. In the South the lack of stability in the lumber market is probably a greater handicap to the lumberman than the lack of fire protection for the relatively fire resistant forests of that region. In many States technical information concerning forest conditions is still very deficient. The State administrations have not had the funds even to determine what the forest resources of the States are or how fast they are being exhausted.

Finally, the private owner is not going to be persuaded, and ought not to be persuaded, to undertake any measures which involve financial sacrifice, unless he can be assured that the results of his investment will not be destroyed by fire before he can realize upon them. A State that spends money to demonstrate forestry and yet fails to protect its forests is putting the cart before the horse. Where the danger of destruction by fires is serious, the private owner must feel an absolute confidence in the fire-protection service of the State, a confidence equal to his confidence in the soundest business concerns, before he can be expected to invest enough money to be worth mentioning in reforestation or in the conservative treatment of his growing stands. The need of protecting forests against the ravages of insects and fungi, also, is not infrequently as important as the need of protection against fire, and it generally demands even greater technical skill to discern the difference between effective expenditure and extravagance. A legislature which diverts funds from fire-protective work before adequate protection has been established, in order to purchase lands for forest reserves, ought at least to show the special need of such diversion.

SUMMARY

Improper legislation and appropriation are inexcusable, since legislatures can always secure the technical advice necessary for sound legislation from those who are thoroughly equipped by training and experience to supply it. Justice to private owners frequently requires that the forest policy of the State be frankly announced. If the policy

of the State is muddled, the private owner has certainly no alternative but to follow a short-sighted policy. He cannot be expected to have confidence in or to exercise greater conservatism than the State upon which he must depend for protection.

The writer reaches the following conclusion, then, in respect to State ownership of forest lands:

1. Every State ought to maintain perpetual ownership of the forest lands unsuited to annual operation which are now within its possession, and the burden of proof ought to be placed upon every proposition for disposing of forest lands in the ownership of a State.

2. As to projects of land purchase by a State:

(*a*) In so far as the projects are intended to protect areas of esthetic or recreative value, they are highly commendable if the nature of the project is understood and agreed upon by the body politic.

(*b*) In so far as the projects are intended to protect domestic water supplies, they are also commendable if there is actual use or genuine need of the water supplies in question.

(*c*) In so far as the projects are intended to regulate stream-flow and to prevent sedimentation, it is doubtful whether the purchase of forest land gives effective or even appreciable results, except perhaps in certain very mountainous regions and in certain regions very easily eroded.

(*d*) In so far as the projects are intended to produce timber, there is no reason for considering them as other than ordinary financial investments, except when soil destruction is actually threatened by private ownership, when patriotic considerations, if agreed to by the body politic, may warrant waiver of the financial point of view.

(*e*) In so far as the projects are intended to serve for the demonstration of methods in forestry, they are justifiable only when there is something that can really be demonstrated most effectively in no other way. In general, protection against physical destruction of forests, against uncertain or unfair taxation, and against improper business methods—all of which are essential functions of the State—and also the collection and dissemination of information as to technical forestry and markets, are more effective methods of encouraging better forest administration than are demonstration areas.

(*f*) The possibility of some returns from timber production may render feasible projects urged for esthetic reasons—recreation, protection of domestic water supplies, or the protection of the productivity of soils endangered by private methods—even if these returns are insufficient to pay the cost of protection, administration, and interest on the purchase.

DISEASE CONTROL AND FOREST MANAGEMENT [1]

By F. H. Millen

Assistant to the State Forester of Texas

Heretofore in the practice of forestry, both in this country and abroad, the probabilities concerning the condition of the stand in the future have been given little or no weight in the calculation of the allowed annual or periodic cut in the managed forest, but much deviation from the prescriptions of the working plans has been made necessary in many cases on account of various more or less severe catastrophes, due to several causes, which have exposed the stands to danger of loss. This discrepancy between plans and execution has evidently been due to a lack of data concerning the components of the total loss factor, which should be considered in the calculations. Some of these components, such as windfall, will always present a variable degree of uncertainty, and all of them require detailed and careful observation over long periods to determine with any degree of accuracy their relative importance. Meinecke (1915) brings out the difficulties encountered and possibilities revealed in his development of a study of decay in its relation to one species of timber tree. His conclusions apparently constitute the first attempt ever made to modify the calculations for regulation in a definite way with regard to any one loss factor. This work deals exclusively with the liability of young merchantable and mature trees to loss through decay, but suggests other factors of loss which deserve consideration, such as fire, snow-break, lightning, windfall, insect injury, disease, etc. These factors vary in their susceptibility to definite determination. Some effort is generally made to consider carefully the factors of snow-break and windfall in the determination of and marking for the silvicultural method for the forest. Lightning and frost damage cannot be eliminated, but are found usually in more or less definite zones or areas, and the species managed for or favored on those areas should be selected with due consideration for their resistance to those causes of injury. The fire danger may be approached from the same direction where fire-resistant species can be utilized, but by far the most important field of action in this connection is that of protection from fire, such as is already widely attempted with

[1] Prepared in co-operation with Professors Rankin and Recknagel. Reviewed by Doctor Meinecke.

creditable success. Insects, like disease-producing pathogenes, require special extensive and intensive study to determine their influence on rotation and cutting cycle and the various available means of control. In the consideration of diseases it is advantageous to treat separately with enphytotics and epiphytotics.

Enphytotic Diseases

The effect of enphytotic diseases upon the forest is a more or less constant factor, as far as forest management is concerned; for the forester works over long periods, dealing with cutting cycles and rotations, and variations in the factors influencing decay and other enphytotic diseases are compensating. It is with an enphytotic disease that Meinecke (1915) deals, and his study shows that, given a knowledge of the liability to attack and decay with reference to age and condition, the rotation, and therefore the regulation and distribution of the cut, can be altered to fit the conditions found. In treating with white fir (*Abies concolor*), Meinecke (1915; 59) concludes that thrifty, unwounded trees might be allowed to exceed 150 years of age; wounded but thrifty trees should not be allowed to exceed 150 years, and wounded, suppressed trees should not pass the 130-year mark, because on the average after these respective ages the increment in the several classes of trees is so far offset by decay as to render it unprofitable to keep them longer. A study of decay in other species would undoubtedly result in the establishment of similar rotational limitations.

With regard to the cutting cycle, it is evident that the period must be of sufficient length to produce enough volume above the diameter limit to make a return profitable. On the other hand, it must be as short as such a requirement will permit, in order to reduce the chances for such catastrophes as windfall, fire, frost injury, and lightning injury, which directly reduce the volume of merchantable material and create dangerous infection centers.

In the marking rules, such requirements should be made as would not only comply with the above conditions of the rotation age and the volume produced during the cutting cycle, but would also eliminate as far as possible all diseased trees or trees liable to be infected because already injured in some way. This would reduce the centers from which other trees may become diseased and would gradually accomplish sanitation in the forest.

Epiphytotic Diseases

The problem of dealing with epiphytotic diseases is an exceedingly difficult one, and apparently the only safe method of handling them is

that initiated by the Federal Plant Quarantine Act (August 20, 1912). Meanwhile, until safe quarantine provisions are completed and strictly enforced, some newly introduced epiphytotic disease or some new outbreak of one already occurring in the country is liable to happen at any time.

The effect of an epiphytotic in the forest is frequently that of the speedy death of a large number of trees over a considerable area. It is in this way that growing stock and distribution of age classes are most directly affected. Suppose, for example, that a certain pathogene shows a decided preference for young growth of a certain species, either on young trees or on branches of older ones, for its activities. It is evident that the younger the tree, the more susceptible it is and the more liable to complete destruction, and the older the tree, the more likely it is to recover from the attack. It is easily conceivable, therefore, that the entire growing stock of the first age class (1 to 20 years) of the species may be practically destroyed, and serious inroads might also be made into the second and even the third age classes. If the particular species is the only one for which the forest is being managed, the supposed epiphytotic will remove from the stand the entire cut of one twenty-year period in the future, and may necessitate planting to offset this loss in future yield.

The results of such a catastrophe call for a radical readjustment not only in the length of the rotation and cutting cycle, but in the calculation of the allowed annual or periodic cut. It would probably be advisable in the suggested example to retain the same rotation, but to increase slightly the length of the cutting cycle so as to reduce the number of the periods of return by one. For the first rotation following the occurrence of the epiphytotic the allowed periodic cut would be reduced. The volume of the lost age class when it should have reached maturity, divided by the number of cutting cycles retained, would be the reduction factor for each cutting cycle. The remaining volume which is to be cut is also distributed over a longer term of years—the extended cutting cycle—and the allowed annual cut is reduced by that much more than the previously allowed periodic cut. Thus the loss of the volume of one age class is distributed over the rotation, and the felling age increased by a little each period, being at the end twenty years greater than the length of the rotation.

The marking for any cutting during the time of readjustment must be subservient, of course, to the calculated allowed annual cut to a certain degree, but should primarily concern itself with sanitation, even at a considerable sacrifice of the sustained annual yield sought. In many cases it might be imperative to substitute a new species not sus-

ceptible to the disease, for at least one rotation, to insure the complete eradication of it from the area, and to take other measures for control demanded by the special exigencies of the case.

It also frequently happens that a pathogene causing an epiphytotic disease is not selective of any single age class or group of age classes. In such a case, as soon as the disease appears the emphasis in regulation must be taken away from the object of sustained yield and laid upon sanitation, if possible. If sanitation is impracticable because of the extensive occurrence of the disease at the time of its discovery or of the initiation of a systematic management, the regulation must concern itself primarily with damage cuttings, and silviculture should provide for the substitution of resistant or immune species. An example of such a case is given in the working plan for the Luther Forest Preserve, Saratoga County, New York (Cornell University, Department of Forestry, 1916), from which the following is quoted:

"(3) Marking rules:

"Take out actually diseased chestnut at present, because the removal of all chestnut would leave too open stands. Also there is a chance that the blight will be checked and chestnut may once more take its place in the forest."

In addition, the general planting plan in the working plan provides for reforestation with white pine (*Pinus strobus*) and red pine (*Pinus resinosa*) in mixture.

The object here is for cutting to keep pace with the advance of the disease and for the planting to replace the present stand containing this susceptible species with species of an entirely different character.

In conclusion, the combining of disease control with intensive forest management calls for an adjustment of the rotation, cutting cycle, and marking rules in such ways as, in the case of enphytotics, to control the disease by measures of sanitation, and by limiting the felling age so that loss is minimized; and in the case of epiphytotics, to make "sanitation" cuttings, or damage cuttings, or both, and employ certain silvicultural measures, such as the substitution of other species which are more resistant or immune.

LITERATURE CITED

Department of Forestry: Working Plan for the Luther Forest Preserve. N. Y. State College of Agriculture at Cornell University, Ithaca, N. Y., 1916. (Unpublished MSS.)

Meinecke, E. P.: Forest Pathology in Forest Regulation. U. S. D. A. Bulletin 275: 1-63, 1915.

Recknagel, A. B.: The Theory and Practice of Working Plans. 2d edition. Pls. 1-6, figs. 1-2, I-XIV, 1-265, 1917.

WHAT IS WASTE?

By Prof. R. C. Bryant

Yale School of Forestry

In the April number of *McClure's Magazine* there appears an article on "The Wealth in Waste," by Waldemar Kaempffert, editor of *Popular Science Monthly*. In a brief introduction the editor of *McClure's* states that "no one in this country can write such popular business talks." The article in question may possibly be regarded as popular, but in so far as it treats of the waste problem in the lumber industry it is inaccurate; in fact, some statements are so palpably in error that one is at a loss to understand from what source the author secured his "facts."

In speaking of pulp manufacture, he says: "Dozens of chemists have endeavored to save money by devising ways of utilizing the liquors of what is known as the 'sulphite process.' . . . As yet a commercially practicable method has not been worked out." For some years chloroform, muriatic acid, lard substitutes, and road dressings have been a by-product of at least some pulp mills. That it is both feasible and profitable to utilize the waste liquor was long ago demonstrated and the methods applied.

In dealing with lumber manufacture, the author's conception of waste is believed to be wrong, since it is not sound economically to regard as "waste" that portion of the product which cannot be placed on the market at a price sufficient to cover the cost of manufacture and sale. It is a greater economic waste for a manufacturer to destroy capital in this manner than it is to leave the product in question in the woods or to burn it at the manufacturing plant. Much time and money have been spent in experimental work, yet the ablest chemists of the country have not yet told the lumbermen how they may profitably utilize much of the wood refuse that is incident to the harvesting of forest crops.

In discussing lumber manufacture, it is stated that "only 15 per cent of the standing tree appears as finished lumber after the ax and saw have done their work; more than 65 per cent is left on the ground. The money lost in the form of mill waste is far greater than the profit made from salable lumber."

Under no conditions that exist at the present time is it probable that

such wasteful utilization exists, since to leave 65 per cent of the cubic volume of a tree in the forest would necessitate leaving a large part of the bole in the forest—a practice nowhere existing at the present time.

As an illustration of ordinary utilization practice, there may be cited the case of a 26-inch d. b. h. southern yellow-pine tree recently measured by the writer and which showed the following cubic contents:

	Contents, cubic feet	Per cent of total contents
Stump	3.996	3.02
Bole	113.828	86.09
Limbs	14.357	10.89
Total	132.181	100.00

Of this amount, 98.537 cubic feet, or 74.5 per cent of total cubic contents, was taken to the sawmill, instead of the 35 per cent mentioned by the author of the article.

The bole when sawed into lumber would yield the following products:

	Amount, cubic feet	Per cent of total volume of tree
Lumber (rough)	59.33	44.89
Sawdust	17.993	13.61
Slabs	20.930	15.83

The final yield of lumber, therefore, was 45 per cent of the volume instead of 15 per cent, as stated in the article.

From a 14-inch tree, measured at the same time, there was taken to the mill 67 per cent of the total volume, the lumber yield being 46.5 per cent of the total cubic volume of the tree.

While the measurements of two trees are not a sufficient basis for concluding that the above percentages may be assumed as an average, yet the fact that the measured trees represented the general run of the timber being logged, and the final results were so nearly equal, shows that the yield in lumber far exceeds 15 per cent of the total cubic contents of a tree.

In discussing sawdust as a waste product, the reader is led to believe that it is a source of heavy expense to the mill operator, since "there are not enough dolls to stuff into lifelike rotundity with it, nor enough bar-room floors to sprinkle with it. . . . Others try to burn it, but without much success."

As a matter of fact, for years sawdust has been burned in sawmill power-houses with *great success*, and has furnished and still furnishes the chief fuel which provides power for driving sawmill plants. Far from being a liability to the sawmill operator, it has a distinct money value to him, because it permits his power-house boilers to be stoked

mechanically, and did he not have sawdust some other fuel would have to be provided at an increased cost. At many sawmill plants not only is all the sawdust used as fuel, but, in addition, planing-mill refuse; and often it is necessary to grind slabs and edgings into fine fuel in order to provide material for keeping the fires going at night and during Sundays and holidays.

Sawdust is not a waste, since fuel is an essential, and sawdust is the cheapest fuel available to the manufacturer. If the sawdust-disposal problem was the only one now confronting the lumberman, he would long ago have ceased to worry.

"In our Southern States the wastes of longleaf yellow pine alone would produce every day forty thousand tons of paper, three thousand tons of rosin, three hundred thousand gallons of turpentine, six hundred thousand gallons of ethyl alcohol, together with fuel sufficient to meet the requirements of all the industries that could produce these products."

I do not have available facts to prove or disprove this statement, yet it is probable that in making this estimate the author has grouped all southern pines together, large-plant refuse and small-plant refuse indiscriminately. So far as I know, it has not yet proved profitable in many cases to even distil longleaf pine stumps, which contain a greater resin content than either shortleaf or loblolly pines and a greater resin content than slabs or top wood of longleaf pine itself. Further, it requires large quantities of raw material to make these by-product plants successful; hence the refuse from the thousands of small mills is not available, since the expense of collecting and transporting the raw product to a central plant is prohibitive.

The author asks why bankers, who have a highly developed faculty for making money, do not turn to the forest instead of the automobile and munitions factories for investment purposes. They do not for many exceedingly good reasons. There is money to be made in automobiles and munitions, but the man who has made money out of the refuse of southern yellow-pine forests is hard to find, not because men have not tried it, for they have, but because it costs more to manufacture a greater part of this refuse into a salable commodity than the public is willing to pay for it. There are isolated cases where, under especially favorable conditions, paper and products of distillation are recovered from *sawmill refuse;* but so far no one has devised a means whereby rough tops and the limbs of southern yellow pine can be manufactured into a product at a reasonable profit. Processes for doing this are known, but costs are prohibitive.

ALNUS OREGONA: ITS VALUE AS A FOREST TYPE ON THE SIUSLAW NATIONAL FOREST

By Herman M. Johnson

Forest Examiner, Forest Service

INTRODUCTION

The genus *Alnus* comprises many species scattered on both sides of the equator in various parts of the world, but occurs chiefly in the northern hemisphere. Many of them are only shrubs, but there are six species in the United States that belong to the tree class. The different species cover much of this country and there are few large areas upon which one or more are not present. The alders are old inhabitants of the earth. They occurred in the Eocene and Miocene forests of the old and new world and have held their own throughout the ages. Apparently, they have neither gained nor lost in extent of range during the hundreds of thousands of years which measure their tenancy upon the earth.

The Oregon or red alder is the largest of the alder group in this country and occurs only on the Pacific Coast. The red alder is so named because newly cut wood rapidly turns a reddish brown. This applies only to the sapwood; but since the trunk is largely sapwood it is an important matter. This coloring is probably due to some chemical change in the sap when exposed to the air.

SILVICAL CHARACTERISTICS

The *Alnus oregona*, or red alder, as it is commonly called, belongs to the birch family, Betulaceæ. It is the largest and most important of the alder group in this country. It extends from southern Alaska to southern California, a north and south range of over 2,000 miles. Its altitudinal limit is 7,000 feet.

It is a tree of moist situations, hence occurs mainly along streams and in river bottoms. Normally it occurs in mixture with the other moisture-loving species, but frequently forms pure stands.

The red alder, although the most tolerant of this genus, when compared with its associated broadleaf species it is below the average in this regard. In pure stands the density of its crown canopy is less than 0.75.

The tree matures in about 50 years, although many older ones are found. It ranges in height from 40 to 90 feet and from 8 to 30 inches in diameter, depending entirely upon the conditions under which it has developed. In close stands the trunk is usually straight and clears itself of branches for three-fourths of its length. In open stands the tree is apt to fork and be very branchy.

The bark is thin and smooth, light ashy to whitish gray. This thinness of bark renders it susceptible to fire injury. The leaves are from 2 to 6 inches long.

The male and female catkins occur in pendulous clusters at or near the ends of the branchlets. The male catkins are 3 to 6 inches in length, cylindrical in form, and appear in the early spring. The female catkins or, more properly, cones are less than an inch in length and nearly round. These appear in the spring from three to four weeks later than the male catkins. The cones remain green until the seeds are fully ripe, but finally turn brown. The seeds are liberated during the fall and winter. The old cones remain on the trees for several months following the dispersal of the seed. The seeds have thin narrow wings and are about the size of a radish seed. They scatter widely and germinate freely. This latter is shown by the rapid spread of the species and by the short time within which cleared land in its vicinity will revert to alder growth when not continually utilized.

THE ALDER AS A TYPE

As a forest type the red, or Oregon, alder fills an important position on the Siuslaw Forest. Some time in the forties the entire region was devastated by a fire which destroyed almost the entire existing stands of Douglas fir. Previous to the fire undoubtedly the alder, forming only an incidental species, was confined to narrow strips along the streams and river bottoms. During the years since the original fire many of the areas have been repeatedly burned over. In spite of this handicap, the alder has continuously spread until now it forms an important temporary cover type embracing hundreds of acres which otherwise would be given over to brush. This rapid spread has not been confined alone to the broad bottoms, but is spreading up the higher slopes and in some cases reaching the tops of the higher ridges. The value of this species has not been given proper recognition, and it is proposed in this report to show the purpose it has served and will continue to serve until crowded out by the original and more valuable Douglas-fir type.

The value of alder as a type will be shown under the following headings:

1. Its value as a nurse crop.
2. Its value as a soil builder.
3. Its value for fire protection to second growth and reproduction.
4. Its commercial value.

1. *Its Value as a Nurse Crop*

In journeying throughout the forest the large bodies of alder present themselves conspicuously to one realizing that they form such extensive stands in a region in which the Douglas fir reaches its optimum development. Scattered through this alder growth are frequent Douglas-fir trees from 40 to 70 years old. The oldest and largest of these trees are found among the older alder thickets. Evidently these isolated firs are the remnants of reproduction following the original fire and which, due to their location among the alders, have escaped destruction by the numerous fires of the subsequent periods. It has also been noted that as one progresses toward the outer edge of these alder thickets scattered younger fir occur, which evidently resulted from the seeding of those larger firs already mentioned. That these seedlings are enabled to develop is due to the comparative openness of the alder crown canopy. That this reproduction has survived has been due to the protection afforded them by the encompassing nurse crop.

Many examples are found where heavy fir reproduction is occurring in the openings adjacent to the alder growth. In the midst of this reproduction young alder is rapidly springing up that will act as a future protection of the more valuable conifers, which in the meantime will have attained sufficient growth, so that its development will not be at all affected by the alder canopy.

Then, again, openings are found in which scattered seed trees occur which have been preserved by the surrounding alder growth. In such situations dense reproduction has resulted which is now crowding the alder slowly, but surely, back to the canyons whence it originally came. Also among the dense stands of second-growth fir, 30 to 50 years old, the decayed remnants of former alder growth are frequently found, showing that after the alder has served its purpose as a nurse crop it ultimately yields to the Douglas fir, which forms the permanent or natural forest type in this region.

The value of alder as a nurse crop does not lay alone in the protection from fire afforded the more valuable species, but also from the fact that it has the power of rehabilitating those soils that have been

badly burned, hence lacking in many of the soil constituents essential for the best development of the more valuable species. The geological formation of this region is such that although the rainfall is heavy those slopes unprotected by a timber covering dry out rapidly. The alder, as it ascends these slopes, creates a better moisture condition of the soil because of its presence. Hence, taking everything into consideration, the red alder, although a species of comparatively small value, is creating a condition enabling the more valuable Douglas fir to regain a foothold, so that ultimately those large areas now barren will revert to the immense forests which once covered the region and not only create an asset of great economic value, but also one of esthetic value to the people as well.

2. *Its Value as a Soil Builder*

The value of alder as a soil builder has been touched upon under the previous heading, but only to a slight extent. Its importance in this respect has been realized in part by many; but to what extent it has added to the economic value of lands within and adjacent to the Siuslaw Forest has never been fully appreciated. It is safe to say that many of the prosperous dairy communities on the Oregon coast would not have been possible but for the presence of this species. The greater the development and prosperity of the communities adjacent to and within the Forest the greater will be the increase of transportation facilities, hence larger the market and greater the value of forest products.

The influence of alder growth on the soil is twofold in that it affects both the physical condition and the chemical properties of the sites upon which it grows.

One of the most notable effects is the presence of abundant moisture in the surface soil upon passing from the open areas into the alder growth. The alder is naturally a moisture-loving species and upon moist bottoms its root system is shallow. However, as it advances upon the drier slopes the roots must necessarily seek water at greater depths. The effect of this is to render the soil more friable, hence the moisture of the lower soil strata is rendered available to the surface roots through increased capillary action. This, together with the less loss through evaporation, accounts for the greater moisture content of the soil under alder growth. In this same respect the mulch created under the alder through the accumulation and decaying of debris acts as a moisture conserver. This also greatly enriches the soil through the formation of humus.

Many people have no doubt noted the bunches of nodules present on alder roots, but have failed to recognize their significance. Several specimens of these nodules have been sent to the Madison Laboratory, and examination has shown beyond a doubt that they contain nitrogen-fixing bacteria and perform the same functions as leguminous crops in adding nitrogen to the soil. This action is especially desirable in the coast soils, since repeated fires have depleted the soils of these elements.

The efficacy of the alder as a soil restorer has been demonstrated many times. Taking two adjacent areas similar in all respects excepting that one supports a growth of alder and the other is covered with fern and salal, it has been demonstrated repeatedly that the former will yield excellent forage and garden crops, while the latter is practically unproductive. This is especially true of bench lands.

3. *Its Value for Fire Protection*

The value of alder as a protection to the seed trees and older reproduction that have maintained a foothold throughout the various fires that have swept the region has already been discussed.

On the other hand, during the past seven years approximately ten thousand acres have been replanted and seeded where natural reproduction is inadequate or entirely absent; also there are thousands of acres of brush land carrying stands of very young reproduction which must be protected from destruction by fire. In this respect the alder growth has proven a very valuable and efficient assistant.

A bird's-eye view of the Siuslaw Forest presents a vast network of canyons and draws, each of which carries a heavy growth of alder. In many instances this growth extends up both sides of the ridges, meeting at the top; in others lacking but a short distance of meeting.

The brush ordinarily is less dense beneath the alder and any debris that may be present is always moist, both of which together with the moist condition of the surface soil forms a natural and efficient fire-line. It is only during the seasons of exceptional drought that fire will run beneath the alder, and even then it advances slowly and is easily controlled. These conditions greatly facilitate the protection of the reforested and reproducing areas. The necessity of building extensive fire-lines is obviated, as in almost all cases conditions are such that the construction of a short fire-line only is necessary to connect two alder draws in order to stop a fire advancing along a ridge. Since the open areas on the Forest carry a heavy growth of salal and fern, both of which are very inflammable at certain seasons, the presence of this alder growth is seemingly a wise provision of nature to aid in the re-

establishment of the more valuable Douglas fir, the protection of which would be well-nigh impossible was it not for this.

The greatest source of danger from fire on the Siuslaw Forest lays in its escaping from slashings of homesteaders scattered throughout the Forest. This danger would be greatly increased were it not that the larger per cent of these homesteads are located within the alder growth.

The efficacy of the alder as a fire protection was proven during the season of 1910, when disastrous fires swept the Mt. Hebo region. At this time there were hundreds of acres of valuable reproduction saved from destruction by the surrounding alder growth. This is especially notable, as that season was an exceptionally dry one.

4. *Its Commercial Value*

For years the red alder has been a source of fuel to the Oregon coast. This use is increasing rapidly as the supply of sound fire-killed Douglas fir diminishes. At the present day there are thousands of cords used in this manner. Many cases have been noted where formerly the settlers burned their alder slashings; at the present time they are cutting it into cordwood and selling it on the open market for from $2.50 to $3 per cord for four-foot wood and from $3.50 to $4.50 per cord for 16-inch wood.

An average stand of 30 to 40 year old alder will yield from 30 to 35 cords of four-foot wood per acre, or 35 to 40 cords of 16-inch wood. The higher yield in the latter case is due to closer utilization. In saw-logs an average stand will yield about 7,000 feet, board measure, per acre, though it will vary from 5,000 to 15,000 feet, board measure, per acre.

Until recently the alder was considered useless for saw timber. During the past year approximately 1,500,000 feet, board measure, have been used in the manufacture of furniture. Several drives of logs have been sent to the Portland mills from the Kalama River. These logs bring about $11 per thousand at the mills.

The only data that could be secured relative to logging and milling costs were obtained from a small mill operating near Westlake, Oregon. This region is topographically typical of the alder areas on the coast. Here the logging is done by hand and with horses. The logging cost varies from $3.50 to $4.50 per thousand and the milling from $3 to $5 per thousand. The logs are cut principally into one-inch boards any width, although there is a demand for about one-fourth of the cut in 1½ and 2 inch stock. Logs should be cut from 12 feet to not over 18 feet in length to get the best results in sawing by reason that the longer timbers will pull away at the ends, there being much spring in it.

Logs as low as 5 inches in diameter are sawed, though the average log will run about 12 inches, but 30-inch logs are not uncommon.

Alder lumber, mill run, will bring $20 per thousand, f. o. b. Portland, Oregon. With a reasonable amount of care the lumber does not check badly and can be successfully seasoned by air drying, but the best lumber is produced by seasoning in a moist, dry kiln direct from the saw. This material works easily either vertical or bastard grain and is fairly strong.

The uses to which alder lumber are put are confined entirely to interior uses, as it will not stand exposure to the weather. It is used largely for core stock in veneering, chair seats, and to some extent forms the entire body of furniture. It is also employed in interior work in furniture, such as shelves, drawers, etc., also in cabinet work. Alder will take a good mahogany finish and can be used for an imitation mahogany in place of maple or birch. It is also used to some extent for wood split-pulleys and for piling.

The alder bark is astringent and has been used to a slight extent for tanning purposes.

CONCLUSIONS

Although the Oregon alder has been commonly considered a weed tree and in many respects undesirable, this study has shown that it has been and is yet of great value to the Siuslaw National Forest. Its function as a nurse crop to the more valuable Douglas fir is making possible the restoration of the valuable timber which once covered this region. It is revivifying the depleted soil, making possible the prosperous communities scattered along the coast. Its presence has made impossible the extensive fires which formerly devastated this region. Lastly, its value as a commercial product is being realized, and it may be expected that in the near future it will develop an industry of considerable extent.

AXTON PLANTATIONS

By B. E. Fernow

In the absence of an official record of the silvicultural work done by the former New York State College of Forestry at Axton, and in view of the success of this work as exhibited by the various plantations referred to on page 892 of this volume, the following memorandum of detail may be useful as a record for future reference.

It is based partly on personal memoranda, partly on mere remembrance.

There were plantations made under twelve or fourteen different conditions. The conditions were:

1. In old slash grown up with aspen and brush rather open, without any preparation.
2. The same after cutting and burning brush.
3. Under planting of dense aspen and birch growth, 15 to 20 years; after and without thinning.
4. Underplanting in old hardwood timber.
5. Cutting lanes in dense 15-year-old aspen and birch and planting.
6. The same, but thinned instead of cutting lanes.
7. On poor open sandhill fields.
8. On grassy old pasture, poor sand.
9. On raw humus of heather plants.
10. On wet sour humus soil.
11. On logged, nearly cleared, and brush-burned area.
12. Underplanting a conservatively cut area.
13. A logged area without burning brush.
14. Scattered open places.

The planting stock was mostly two and three year old material, seedlings and transplants (and a few 4-year-old transplants), as the case may be. It was secured for the first (in time) planting from Douglas & Sons, Waukegan, Illinois, and from Heins Sons, Halstenbeck, until the Axton nurseries could be drawn upon.

The species used were mainly white pine, Scotch pine, Norway spruce; a few other species in small numbers for trial were also planted, notably red pine, Douglas fir, blue spruce, and *Abies concolor,* black locust (seeded in spots in the woods) and European larch.

Except on some special sites, where Scotch pine pure was used, the planting was done in mixture.

The planting tool used was mainly the grub-hoe or mattock. Some planting was done with Wartemberg iron.

The first plantation in 1899 was made on about 18 acres of old slash on Stony Creek, grown up to aspen and brush, without any soil or other preparation, with around 43,000 plants brought from Douglas & Sons, the cost of the plants being $5 per thousand, the planting cost being $3.70 per thousand.

In 1900, some 250,000 plants were purchased, mostly from Heins Sons, of which around 120,000 went into plantations, the balance into nursery rows, except a large loss (65,000) occurring through delay in the customs. Four plantations on about 90 acres were made that year. The cost of plants was reduced to $1.85 per thousand, and the planting, including some clearing work, $4.80 per thousand, or altogether $10.70 per acre. Some $50 were spent on the plantations around Axton for weeding, cutting out blackberries, and brush-burning on 30 acres in 24 labor days.

In some of these plantations the planting iron was used to some extent, and in some places two plants were set in the hole, in many cases both surviving, holes 5 to 9 feet apart, about 900 to the acre. An estimate of the amount of planting that could be done with the two tools was 400 plants with grub-hoe and 800 plants with Wartemberg iron.

To locate the plantings for inspection, this can be done by numbering as they are approached coming from Tupper Lake.

No. 1 was made under condition numbered 13, and was burned up; so was

No. 2 made under condition numbered 12.

These two were located north of the road before reaching the old clearings around Forester.

No. 3, on the south side of the road, on an old field with heavy grass sod and very poor dry sand, in furrows and plots, using Scotch pine, white pine, and Norway spruce in alternating rows. A fire destroyed the white pine completely. Of the spruce, few specimens escaped. A considerable number of Scotch pine survived, showing that it was partly fire-proof and at home on the poor soil.

The spruce had made poor growth for about 10 or 12 years; then some specimens showed for the last four years leaders averaging over 20 inches. Apparently, the deep planting with mattock brought the roots into unnatural position, and only when a new naturally shallow-root system had established itself did the trees take on new life. The extension of the root system along the furrows is quite remarkable.

Next, No. 4, north of the road, is a small Scotch pine plantation, partly injured by fire, on slightly better, but similar soil as No. 3.

No. 5, also north of the road, is a pure Scotch pine plantation on very sour, dry, turfy, raw humus, showing this pine successful, even under this condition.

No. 6, on the opposite side of the road, is a plantation of Scotch pine, white pine, and Norway spruce, on somewhat wet ground (condition 10). Here the spruce, as well as both pines, are successful.

No. 7, on the same side, but farther away from the road, in the so-called Huntington clearing, was made under conditions similar to No. 3, except that the sod was not as heavy.

No. 8, on the north side of the road, separated from it by a screen of untouched timber, represents the treatment which was to be given all logging areas, namely, removal of the hardwoods, except leaving young thrifty growth, preferably in groups, burning off brush and planting with conifers, especially white pine and Norway spruce. A few blue spruce also show their adaptation to surroundings.

On the opposite side of the road a similar logging area was brush burned, but not planted, and shows what becomes of the area treated in that fashion.

The other plantings are around Axton. No. 9, to the east, is planted on sandy knolls with Scotch pine, a complete success, the pine now in its eighteenth year, bearing cones, and, indeed, naturally seeding.

No. 10, along the road to Stony Creek bridge, underplanting a young mixed growth of aspen and birch, a fire area, perhaps 15 to 20 years old, with slight opening up; shows that Scotch pine in fresh sand and the humid climate can even be used for this purpose—an entire success!

No. 11, east of Stony Creek bridge, the first plantation made, in 1899, into a slash grown up to aspen, without any preparation whatsoever, is perhaps the most successful, the two pines and spruce vying with each other to take first place, but excelled by the European larch. *Pseudotsuga* for indetermined reasons has only held on to life without satisfactory growth. The same may be said of *Abies concolor,* although lately some specimens have taken on new life. Rabbits may have held back these two species.

No. 12, adjoining, was made on similar area, but after burning the slash, as a consequence of which raspberry threatened to choke out the trees. A fair number, however, survived.

No. 13, located on so-called Driving Camp Hill, adjoining to and partly under old untouched broad-leaf timber.

No. 14, located west of Axton, across Axton brook, was made in a 10 to 15 year old dense stand of birch and aspen, fire area, after opening lanes, and also after general thinning. The openings were not wide enough and the conifers were too much shaded for thrifty growth.

INCIDENTAL RESULTS OF A STUDY OF DOUGLAS-FIR SEED IN THE PACIFIC NORTHWEST

By C. P. Willis,

Forest Examiner, Forest Service

During the fall of 1912, when the collecting and drying of cones for the Douglas-fir seed study were in progress, several interesting questions presented themselves. These were made the basis of small incidental experiments, distinct from, but somewhat related to, the main study. These experiments, which are hereafter discussed, were designed to answer the following questions:

(1) Can cones be collected while still very green without injury to the seed?

(2) On a given tree are small cones inferior to large ones?

(3) Are the large seed of a tree of better quality than the small seed?

(4) What temperature is best for cone drying in a kiln?

(5) After cones are partially opened, are the seed which cannot be shaken out of especially inferior quality, or is it worth while to obtain them by further drying?

(6) Are only the seed which readily shake out of high value, or are the ones left worth securing by further shaking?

(1) *Can cones be collected while still very green without injury to the seed?*

If cone collecting is deferred until all cones seem perfectly ripe, there remains but a short time for gathering them before they start to open. It sometimes happens that some green cones must be picked, if the total quantity desired is to be obtained. In this case it is of value to know the exact effect of the practice, so far as the quality of the seed obtained is concerned. Four trees at Milwaukee Park, Portland, Oregon, and five trees near Carson, Washington, were selected for the study of this question. From each of the nine trees weekly collections were made, starting in early August, when the cones were very green, and continuing to late August or early September, when they had ripened perfectly. For each collection from each tree such points as the following were determined:

1. The appearance of the cones.
2. The number of apparently good seed per cone.
3. The weight of 200 apparently good seed.
4. The per cent good in a cutting test.
5. The per cent good in a germination test.

The figures for the weight of seed seemed to show a decrease as ripening progressed; but since they are not very consistent, these data are hereafter disregarded.

Table 1, for the Carson trees, and Table 2, for the Milwaukee Park trees, show the main results of the study.

TABLE 1.—*Carson Trees (Weekly Cone Collections)*

Date of collection.	Appearance of cones.	Number of apparently good seed per cone.	Cutting test, per cent good.	Germination test, per cent good.	Number of viable seed per cone.
1912.					
Aug. 3....	Cones green..............	23	47	16	3.7
Aug. 10...	Cones green; turning slightly brown.	24	47	18	4.3
Aug. 17...	Much more brown........	23	42	18.5	4.3
Aug. 24...	Fully ripe.................	24	44	16.5	4.0
Aug. 31...	One tree had cones too far open to justify collection.	24 [1]	33 [1]	16.5 [1]	4.0 [1]
Sept. 6....	Four trees had cones too far open.	36 [2]	39 [2]	9.5 [2]	3.4 [2]

TABLE 2.—*Milwaukee Park Trees (Weekly Cone Collections)*

Date of collection.	Appearance of cones.	Number of apparently good seed per cone.	Cutting test, per cent good.	Germination test, per cent good.	Number of viable seed per cone.
1912.					
Aug. 7....	Cones green; bracts slightly brown; seed mostly soft. Contents of seed do not appear "set."	29	56.5	12	3.5
Aug. 14...	Cones rather brown; bracts partly brown; seed mostly firm. Contents of most seed are "set."	34	48.0	17	5.8
Aug. 21...	Most of cones brown; some greenish; bracts brown; seed hard. Contents of seed quite firm; not milky.	35	45.0	21	7.4
Aug. 28...	Cones were starting to open.	26	45.0	19	4.9

[1] Average of four trees. [2] Only one tree.

In both the tables it will be noted that the cones started to open about the end of August. This date is earlier than the ordinary one, because all trees grew at low altitudes, in comparatively warm situations. Three to four weeks before the cones began to open they were entirely green in color, though mature in size and form.

With both sets of trees the perfectly green cones gave seed which germinated satisfactorily, but the quantity of seed obtained was below standard. It is really remarkable that any good seed was secured at this stage of the cones' development. The Milwaukee Park results show that the seed was soft and the kernel very milky at the time of collection, but despite this much of the seed ripened perfectly by the end of the cone-drying period. Though it is possible to collect when the cones are entirely green, it does not seem advisable to do so, since the maximum number of seed is not obtained by this procedure.

The tables are not in perfect accord for the next stage of ripening—the time when the cones begin to turn brown—about a week after the stage above discussed and two to three weeks before the cones begin to open. The Carson trees yielded a maximum quantity of good seed at this time, while the Milwaukee Park trees furnished a satisfactory amount, but not the maximum. It seems fair to conclude that it would be satisfactory, though not usually best, to start collection as soon as the cones begin to assume a brownish tinge. This might lengthen the collecting period by as much as three weeks.

Both tables indicate a falling off in seed quantity, and more noteworthy still in seed quality, toward the end of the period of ripening. The true explanation of this is not clear, but it is attributed to the loss of some of the best seed at the time when the cone scales begin to open.

The following conclusions seem justified:

1. It is possible to secure a considerable amount of good seed from cones entirely green in color. Though the seed is none too well formed when the cones are green it appears that ripening progresses as the cone dries. The largest quantity of good seed is not obtained by this procedure.

2. It seems satisfactory to collect cones when they first begin to assume a brownish hue. The maximum number of good seed may not always be obtained, but at least a fair proportion of the seed is secured.

3. The decrease in the number of seed obtained in the last two cases is seemingly brought about by the failure of some seed to ripen when the cone is picked especially early.

4. When cones are fully ripe, fewer than the maximum number of seed is obtained from them, perhaps because some seed fall from the opening cones at or about the time of collection.

5. In general, it seems that cone gathering may begin two or three

weeks earlier than has been the custom. This may prove advantageous, because weather conditions are apt to be better at the earlier time and because a longer period for collecting is afforded.

(2) *On a given tree are small cones inferior to large ones?*

To answer this question three different lots of cones (each from a different tree) were selected, and for each lot five small, five medium, and five large cones were carefully cut to pieces. This was done to correlate the size of the cone with the number of cone scales and the number of seed, since it seemed possible that large cones might owe their size to the greater development rather than to the greater number of their scales. In this count the small scales at the top and bottom of the cone were disregarded. The number of good seed was determined by cutting tests. Table 3 shows the results obtained.

TABLE 3.—*Comparative Value of Large and Small Cones on a Given Tree*

(Average of three trees)

Size of cone.	Length, inches.	Number of scales.	Number of seed.	Number of good seed.
Small	2	23	26	8
Medium	2½	28	35	18
Large	3	39	50	28

From this table the following conclusions may be drawn:

(1) Large cones actually have more scales developed than small ones, and the number of scales (influencing the number of seed) is proportionate to the size of the cone. But the number of good seed does not necessarily follow from the number of scales.

(2) On a given tree the relative size of a cone is a good indication of its value. Small cones have comparatively few good seed, far fewer than would be expected from a comparison of length alone. Thus a cone one-third shorter than standard has only half as many seed and not one-fourth as many good seed as the standard cone for the tree.

(3) In picking cones it is wise to take from a given tree only the larger, better developed cones.

(3) *Are the large seed of a tree of better quality than the small seed?*

To answer this question a given lot of seed (from one tree) was passed through two screens. Large seed were those which would not pass through a mesh of about six to the inch; medium seed went through this screen, but not through one nine plus per inch; and the small seed passed through both meshes. The relative size of these

classes is likewise shown by the weight per 200 seed, which was 2.875 grams, 2.130 grams, and 1.225 grams respectively. In each case 200 seed were sown in germination tests, with the following results: Large seed, 29 per cent good; medium seed, 15 per cent good; small seed, 6 per cent good. It is clear, therefore, that the large seed of a tree are of much better quality than the small ones.

The practical application of these results depends on the interesting fact brought out in the main Douglas-fir seed study, that large cones produce large seed and small cones small seed. Since small seed are inferior, it is well to collect only the larger of the cones on a tree.

(4) *What temperature is best for cone drying in a kiln?*

For this study a small kiln was built, in which the temperature could be well controlled and the humidity and the air circulation regulated to a considerable degree. The heating was done with a kerosene lamp and the temperature recorded usually with a thermograph. The humidity was increased by means of a steam jet from a kettle—or sometimes by boiling water inside the kiln—and decreased by bettering air circulation, through raising end curtains on the kiln. The humidity was sometimes stated in general terms, as low, high, medium, and in other cases determined by psychrometer readings and given in per cent of relative humidity. The air circulation was classed as slight, good, etc., according as the kiln was tightly closed or otherwise.

Altogether 23 tests of drying were made, each test comprising 10 or 15 cones. Three of the tests were of air drying and the remainder of kiln treatment. The details of the experiments are contained in the original notes, which are on file in the Forest Service office at Portland, Oregon. In the following discussion it will be noted that the subject broadened considerably when the tests started. It is possible to summarize here only the main results, which for the sake of simplicity are discussed under seven subheadings.

(*a*) *Amount of moisture which must be lost before a cone will open.*—Twenty-two tests, dealing with green cones, have recorded figures showing the loss of moisture during various periods of drying. From these it is possible to compute the loss there must be before a cone opens, though the conditions were too variable to permit other than general statements in this regard. It was found that when less than 16 per cent of the green weight was lost the scales did not even start to spread; when 19 per cent to 34 per cent was lost, the scales spread more or less widely without really opening the cone; and when over 35 per cent was lost at least some of the cones opened well.

About two-thirds of the cones opened wide with 35 per cent to 39 per cent of the green weight lost, four-fifths of them when 40 per cent to 48 per cent was lost, and all of them when 51 per cent was evaporated.

(*b*) *Relation between per cent of weight lost by cones and per cent of germination of seed.*—In a kiln treatment it usually is not feasible to remove any of the seed until the drying is finished. In this event there arises a question as to the severity of drying: Is it better to continue the treatment until all cones are open, or will such prolonged drying injure the quality of the seed? In this connection the following results are illuminating: When 35 per cent to 39 per cent of the cone weight was lost, the germination of the seed was 28 per cent; when 40 per cent to 44 per cent was lost, the germination was reduced to 18½ per cent; and with 51 per cent lost, only 2 per cent of the seed germinated. (All germination figures are low because the seed was not cleaned, and much hollow and wormy seed was therefore sown in the tests.) It is very evident that prolonged drying is disastrous, and that the treatment should be shortened even to the point of wasting such cones as do not open readily. Probably not over 40 per cent of the green weight of cones should be evaporated, if the seed can be removed only when the drying is finished.

(*c*) *Factors which influence cone drying.*—Table 4, which summarizes the main results of the cone-drying tests, is arranged according to the degree of drying, as indicated by the per cent of weight lost by the cones. A casual examination of the table shows that drying is the complex result of temperature, humidity, and air circulation.

Other things being equal, it is of course certain that the rapidity of drying will be proportionate to the temperature maintained. With low humidity and fair circulation, a temperature of 70° F. caused a loss of 11 per cent to 16 per cent of weight in nine hours, while one of 100° F. for the same period caused a loss of 35 per cent to 44 per cent; a temperature of 80° F. for 19½ hours caused the same loss as one of 120° F. for 6½ hours—39 per cent.

It is likewise certain that drying progresses at a rate proportionate to the relative humidity, other things being equal. At a temperature of 100° F. and with slight circulation of air, a relative humidity of 70 per cent was accompanied by a loss of 19 per cent, as contrasted with 27 per cent when the humidity was 40 per cent. At 130° F. a relative humidity of 56 per cent resulted in only 19 per cent loss, while one of 16 per cent caused 39 per cent loss.

The result of air circulation is shown by the fact that at 120° F. a slight circulation (humidity 17 per cent) caused a loss of 34 per cent,

TABLE 4.—*Comparison of Methods of Drying*

Method.						Pounds of seeds obtained, per cone.	Per cent moisture lost, cones.	Germination per cent, seed.	
Place.	Period, hours.	Temperature, ° F.	Humidity, per cent.	Circulation.	Special features.			After kiln drying.	After subsequent air drying.
Open air...........	9	70	Low	Fair	In wind, but not in sun.	10	11	..	..
Open air...........	9	70	Low	Fair	In wind and sun.	8	16	..	..
Kiln	10	100	70	Slight	....	13	10	..	16
Kiln	10	130	56	Slight	....	19	20	..	0
Kiln	10	120	30	Slight	....	16	21	..	13½
Kiln	10	140	46	Slight	....	21	21	..	1
Kiln	10	100	40	Slight	....	11	27	..	18
Kiln	10	120	21	Slight	....	17	31	..	33
Kiln	10	120	17	Slight	....	18	34	..	42
Kiln	9	100	Low	Fair	....	7	35	37½	..
Kiln	10½	73–123[1]	Low	Fair	....	5	38	40½	..
Kiln	9	80–120[1]	Low	Fair	....	6	38	12½	..
Kiln	6½	120	Low	Fair	....	3	39	17½	..
Kiln	19½	80	Low	Fair	....	4	39	32½	..
Kiln	10	130	16	Slight	....	20	39	6	28
Kiln	10	100	25	Good	....	12	40	3	..
Kiln	10	120	22	Slight	....	15	42	7	..
Kiln	9½	100	Low	Fair	....	2	44	39½	..
Kiln	21	120	Low	Fair	....	1	45	4	..
Kiln	10	140	14	Fair	....	22	48	0	..
Kiln	8½	120	12	Good	....	14	51	3½	..

[1] Rising.

as contrasted with 51 per cent loss where the circulation was good (humidity 12 per cent). While the humidity caused part of this difference, the effect of air circulation also seems clear.

The whole matter of drying is made more complicated by the interrelation there is between temperature, humidity, and air circulation. An increase in temperature causes a lowering of the relative humidity and ordinarily an increase in the rate of circulation. An increase in circulation usually carries away surplus moisture, causing a decrease in humidity, and often causes likewise a decrease in temperature.

(*d*) *Conditions in cone drying which affect the germination of seed.*—One lot of cones was dried for 10 hours, with 130° F. average temperature, 56 per cent relative humidity, and poor air circulation. Another was similarly treated, except that the humidity averaged only 16 per cent. In the first case the germination was zero and in the second case 6 per cent for seed extracted after kiln drying and 28 per cent for seed which was protected by closed scales during the time in the kiln and subsequently extracted by air drying. The 28 per cent is directly comparable with the zero figures, for the treatment with high humidity opened none of the cones and the seed was therefore later obtained by air drying. It is evident: (1) That high humidity with fairly high temperature may kill seed, even though they be protected by closed scales, and (2) that low humidity with fairly high temperature may seriously injure seed exposed by the opening of scales without materially affecting seed protected by closed scales.

The explanation of these results is of interest. The temperature of the kiln is from some standpoints a matter of minor importance. A main consideration is whether the seed themselves become dangerously heated in drying. This depends largely upon whether the heat is conducted readily to them and in turn upon the abundance of moisture, which is a very much better conductor than air itself. Therefore if a cone is wet, or if the relative humidity of the air is high, an air temperature which otherwise would be harmless to seed may prove exceedingly dangerous.

The seed protected by the closed scales in the treatment where the humidity was low were evidently uninjured by the high temperature, proving that heat was not conducted to them in dangerous degree. The seeds not so protected were seriously damaged, but it appears not through superheating. It seems rather that too much moisture was evaporated from the seed, and that drying instead of heating was the direct cause of loss. The exposed seed was 10 per cent lighter than the protected seed, and though this seems a small difference it is reason-

able to suppose that it might have vast effect, since the moisture in no case forms a great proportion of its weight. The theory of drying as the cause of loss received support from the discussion under (*b*), where it was shown that excessive drying of the cones went hand in hand with reduced germination.

A temperature of 130° F. has never been considered high for a kiln, yet even it was injurious in the tests made. The difficulties with it may be summarized as follows:

1. With moist cones or air, the heat may be conducted to the seed so readily that it becomes superheated.
2. With dry cones or air, much of the seed may become dangerously dry in kiln treatment, even before the majority of the cones open.

(*e*) *Best temperature for cone drying in a kiln.*—The average figures of Table 4 show the following germination, as correlated to the temperatures used:

140° F., one-half per cent germination.
130° F., 6 per cent germination.
120° F., 8 per cent germination.
100° F., 26½ per cent germination.
80° F., 32½ per cent germination.

These results are very striking, as indicating the inadvisability of using temperatures at all high if the cones are green. In general, the seed must have been superheated through the rapid conduction of heat by the moisture present. In some cases, however, excessive drying is doubtless the direct cause of loss. It appears that green cones are not well adapted to kiln treatment.

These results can be applied only to green cones. Test 23 (not given in Table 4) dealt with moderately dry cones, and with these the temperature averaged 150° F., and for a few minutes reached 200° F., and the relative humidity averaged about 22 per cent. Nevertheless the germination was 10 per cent, which was better than the average for 120° F. There seems nothing improbable, therefore, in 140° F. being suitable for cones moderately dry. Nevertheless it is believed best to use a temperature as low as is compatible with economy, for a high temperature always introduces the danger of excessive drying of seed, even if it does not involve superheating.

(*f*) *Rising temperatures as compared with uniform ones.*—Two tests were made with temperatures rising gradually from 73° F. and 80° F. to 120° F. The purpose was to compare these with runs having uniform average temperatures of 100° F., and determine whether the

gradual increase of heat was advisable. As it worked out, the germination was variable, but averaged exactly the same (26½ per cent) in each case. It therefore seems that it was not worth while to employ gradually rising temperatures under the conditions of the tests. Nevertheless it appears probable that with higher average temperatures, and especially with fairly moist cones at higher temperatures, it would pay to start with a low heat. This seems true, because it is now clear that high temperature is particularly dangerous when moisture is abundant, which is at the beginning of a run in most cases. The fact that 120° F. at the end of the rising temperature tests did not affect the germination more than 100° F. did in the uniform temperature tests is further proof along the same line.

(*g*) *Conclusions regarding cone drying:*

1. Cones must lose at least 35 per cent of their green weight to open at all well. Almost all cones open when 40 per cent to 48 per cent, and all when over 50 per cent is evaporated (unless the scales are under pressure in drying, when they may never completely open).

2. If seed cannot be extracted during drying, it is unwise to prolong the drying indefinitely. As a rule, not over 40 per cent of the green-cone weight should be evaporated, for the seed itself dries out dangerously beyond this point. This may often mean wasting some cones, which do not open readily.

3. Drying is the complex result of temperature, humidity, and air circulation.

4. A relatively low temperature (even 130° F.) may be fatal to seed if the cones are green or the atmospheric humidity high. In this event the heat is too readily conducted to the seed.

5. A relatively low temperature (even 130° F.) may be dangerous if any of the seed happens to be much exposed during treatment, and especially so if the humidity is low. Here the effect would be excessive drying, and even a loss of 10 per cent of the weight of the seeds may be enough to be highly injurious.

6. With green cones, which are not well adapted to kiln treatment, a uniform temperature of over 100° F. is apt to cause great loss, largely through the superheating of the seed.

7. Cones moderately dry can be exposed to much higher temperatures. Perhaps 140° F. is perfectly satisfactory. Nevertheless the temperature should be as low as is compatible with economy, for great heat always introduces the danger of excessive drying, even if it does not involve the superheating, which is most common when moisture is abundant.

8. Rising temperatures appear to have much to commend them if high temperatures are to be used and little to commend them in the reverse case. This subject, however, has not been sufficiently investigated.

(5) *After cones are partially opened, are the seed which cannot be shaken out of especially inferior quality, or is it worth while to obtain them by further drying?*

Three lots of cones (each from a separate tree) were found to be only partly opened after a rather prolonged air drying (in the greenhouse at the Wind River Experiment Station). After all seed which could be extracted were obtained, the question of the advisability of still further drying came up. To decide this an additional three to four weeks' drying was given, with the following results:

State of cones.	Weight of cleaned seed obtained, grams.	Weight of 200 seed, grams.	Germination, per cent of seed.
Partly open..................	70.414	2.385	40
Fully open....................	7.913	2.333	43

It will be noted that the seed last obtained were just as satisfactory as those secured from partially opened cones, but that a relatively small amount was secured. If the extra drying can be done at slight expense, it would doubtless pay to do it.

(6) *Are only the seed which readily shake out of high value, or are the ones left worth securing by further shaking?*

The shaking tests were made with a six-sided wire-screen box about 2 feet by 3 feet in size, which was rotated by hand by means of a crank. This differed from the ordinary cylinder screen only in shape, being square instead of round in cross-section.

Twenty-five cones from one tree were used in the first test. It was found that altogether these cones had 1,023 apparently good seed, an average of 41 per cone. Five revolutions of the screen, or one-quarter minute of shaking, secured 66 per cent of these. An additional two minutes, or about 40 more revolutions, brought 11 per cent more. Still another shaking, 60 revolutions in three minutes, gave 6 per cent additional, making a total of 83 per cent of the seed obtained. The remainder could be secured only by cutting the cones to pieces. The germination per cent for the seed obtained by shaking was respectively 41, 47½, and 33½ per cent. It seems that the seed last obtained was sufficiently valuable to make it worth securing, though the quantity of it was not large.

Tests 2 and 3 were somewhat similar to the one just described, except that the amount of débris at each turning and the weight of the

seed, indicating its size, were also obtained. The average figures for these tests are:

Time of shaking, minutes.	Number of revolutions.	Seed and débris.		Weight of 200 seed.	Germination, per cent.
		Total weight, grams.	Per cent débris.		
1	28	272.87	72	2.390	31
4	112	186.93	83	2.427	25
5	140	128.90	87	2.370	24

The number of germinable seed obtained was 1,980 the first shaking, 650 the second, and 335 the last time. Though the last amount is small, it seems worth obtaining.

The fourth test corroborated the results of the other three, but needs no special mention, except to note that the germination per cent was very much higher with the seed later obtained than with those first shaken out.

The conclusions may be stated as follows:

1. Seed which does not shake readily from cones is usually of high quality and is worth saving, unless extra shaking is for some reason too expensive.
2. The seed last shaken out are apparently no smaller than those which are first extracted.
3. The germination per cent is sometimes, but by no means always, slightly low with the seed last obtained.

METHODS OF HASTENING GERMINATION

By S. B. Show

Forest Examiner, Feather River Experiment Station

In the spring of 1913 the Feather River Experiment Station made a number of tests with hastening germination. The technique of the work was faulty, in that the germination period was only 90 days, only 100 seed were used in each test, and incomplete records were kept. This study was later dropped because fall sowing has solved the problem of slow germination of sugar pine. It may occasionally happen, however, that, on account of early snow, fall sowing is impossible, and in such cases the results of the tests at least indicate the methods of treatment which promise success. Similar tests were made at Pilgrim Creek, in 1911, but the results have never been made available.

The following tables summarize the results of the tests carried on by the Feather River Station. These are not regarded as conclusive, and are given here merely as suggestive of the tendency. They do indicate, however, that soaking in solutions of sulphuric acid gives the best results for sugar pine.

TABLE 1.—*Methods of Treatment—Sugar Pine*

Treatment	Germination in 90 days	Per cent of total germination, days									Number of tests
		10 days	20 days	30 days	40 days	50 days	60 days	70 days	80 days	90 days	
Untreated	1.0	0	0	0	0	0	0	0	0	100	3
Scalded	0.0	0	0	0	0	0	0	0	0	0	2
Warm water	2.0	0	0	0	0	0	50	50	100	100	1
Water 98°, 1 hour	0.0	0	0	0	0	0	0	0	0	0	1
Water 77°, 1 hour	2.0	0	0	0	0	0	50	100	100	100	1
Shell cracked	1.0	0	0	0	0	0	0	0	100	100	1
Shell cracked and soaked in cold water	2.0	0	0	0	0	0	0	90	100	100	1
Shell cracked and soaked in warm water	0.0	0	0	0	0	0	0	0	0	0	1
Shell cracked and soaked in hot water	2.0	0	0	0	50	50	100	100	100	100	1
4 per cent H_2SO_4	7.0	0	0	0	14	57	86	86	100	100	1
2 per cent H_2SO_4, 1 hour	8.0	0	0	12	25	37	62	75	100	100	1
1 per cent H_2SO_4, 1 hour	3.0	0	0	0	0	0	0	33	33	100	1
½ per cent H_2SO_4, 1 hour	6.0	0	0	0	16	16	33	50	83	100	1
½ per cent H_2SO_4, 1 hour (after cracking)	2.0	0	0	0	0	0	0	80	100	100	1
Warm solution of chloroform	3.0	0	0	0	0	33	67	67	100	100	1
Medium solution of chloroform	4.0	0	25	50	50	75	75	75	100	100	1
Strong solution of chloroform	0.0	0	0	0	0	0	0	0	0	0	1
Air solution of chloroform	2.0	0	0	0	0	0	50	100	100	100	1
1 per cent chloroform, 1 hour	1.0	0	0	0	0	0	100	100	100	100	1
Weak solution HCL	3.0	0	0	0	0	0	33	67	100	100	1
Medium solution HCL	2.0	0	0	0	0	0	50	100	100	100	1
Strong solution HCL	2.0	0	50	100	100	100	100	100	100	100	1
1 per cent HCL, 1 hour	2.0	0	0	0	0	0	0	50	100	100	1

TABLE 2.—*Summary—Sugar Pine*

Method of treatment	Total germination in 90 days	Number of tests
Untreated	1.0	3
Scalded	0.0	2
Soaked in water	1.3	3
Shell cracked	1.0	1
Shell cracked and soaked in water	1.3	3
Soaked in H_2SO_4	6.0	4
Soaked in chloroform	2.0	5
Soaked in HCL	2.2	4
Shell cracked; soaked in ½ per cent solution of H_2SO_4	2.0	1

Germination per cent so low that results are practically worthless for showing the comparative rapidity of germination.

TABLE 3.—*Western Yellow Pine*

Method of treatment	Germination per cent in 80 days	Per cent of total germination after sowing, days								Rapidity factor
		10 days	20 days	30 days	40 days	50 days	60 days	70 days	80 days	
Untreated	68.0	0	0	0	1	3	32	56	100	67
Soaked in water at 125° for 1 hour	74.0	0	1	1	1	7	29	65	100	65
Soaked in water at 90° for 1 hour	71.0	1	1	1	3	15	30	80	100	63
Soaked in water at 63° for 1 hour	70.0	0	3	4	4	9	44	80	100	61
Soaked in 1 per cent of HCL, 1 hour	77.0	0	3	3	4	11	50	78	100	60
Soaked in 1 per cent solution of chloroform, 1 hour	64.0	0	3	17	22	45	75	98	100	51
Average	71.0	0	2	4	6	15	43	80	100	61

All seed from same lot; 100 seed in each test.

Each method of treatment, except soaking in chloroform, apparently increased the germination per cent. The differences are so slight, however, that they may very easily be due to variation in the seed. The only marked increase in germination per cent was in seed treated with hydrochloric, and the only marked difference in rapidity was from chloroform-treated seed.

TABLE 4.—*Jeffrey Pine*

Method of treatment	Germination per cent in 80 days	Per cent of total germination by 10-day periods								Rapidity factor
		10 days	20 days	30 days	40 days	50 days	60 days	70 days	80 days	
Untreated	50.0	0	40	64	68	72	88	98	100	23
Boiling water, 5 seconds	45.0	0	47	71	75	92	94	100	100	21
Water 91°, 1 hour	50.0	0	0	10	16	50	78	96	100	50
1 per cent HCL, 1 hour	52.0	0	21	53	53	68	87	98	100	27
1 per cent chloroform, 1 hour	51.0	0	19	47	69	75	81	100	100	33
Average	50.0	0	25	49	56	71	86	98	100	31

All seed from same lot; 100 seed in each test.

No method of treatment increased the germination to any extent, and the untreated seed was exceeded in rapidity by but one lot, and then only slightly.

TABLE 5.—*Incense Cedar*

Method of treatment	Germination per cent in 80 days	Per cent of total germination by 10-day periods								Rapidity factor
		10 days	20 days	30 days	40 days	50 days	60 days	70 days	80 days	
Untreated	26.0	0	23	47	57	85	92	96	100	33
Water 110°, 1 hour	24.0	0	20	50	50	67	71	83	100	30
Water 55°, 48 hours	24.0	0	0	4	25	33	67	79	100	55
Water 72°, 1 hour	32.0	0	0	0	0	28	72	88	100	56
1 per cent HCL, 1 hour	31.0	0	0	15	42	53	84	100	100	47
1 per cent chloroform, 1 hour	21.0	0	0	24	24	24	62	81	100	56
Average	26.0	0	7	23	33	48	75	88	100	46

All seed from same lot; 100 seed in each test.

The untreated seed gave results equal to that soaked in water at 110°, and better than other methods of treatment.

PLANTING EXPERIMENTS ON THE SAND-DUNES OF THE OREGON COAST

By Thornton T. Munger

Forest Examiner, Forest Service

Along a portion of the Oregon coast fronting on the Pacific Ocean is a line of sand-dunes which in height, rapidity of movement, and extensiveness rival those of any other part of the United States. This strip of sand wastes varies from one-half mile to two miles in width. In places there are wide flats across which the sand is driven before the almost daily southwest or northwest winds without forming dunes; in other places it piles up in large hills, some of them over 100 feet high, which move inland, encroaching upon and burying forests and cranberry marshes. At the mouths of several of the large rivers which enter the ocean diagonally the sand which drifts across the spits into the harbors is a serious economic obstacle to the maintenance of a proper channel depth. The most extensive and uninterrupted stretch of sand-dunes is between the Siuslaw River and Coos Bay, a distance of 40 miles, most of which is within the Siuslaw National Forest.

Because of the economic desirability of checking this sand movement and putting this waste territory into productive use, a reconnaissance study of the region was made by the Forest Service in 1910. One of the interesting things brought out in this study is the fact that many of the old dunes—which for some unknown reason had been checked in their progress after getting about so far back from the coast—are well reclothed with herbage, brush, and even with a forest of lodgepole pine (shore pine) and other species. In places on the inter-dune flats a thrifty herbage is occupying the ground, even in spite of considerable constant sand movement. It is apparent that conditions here are normally rather favorable for vegetation: the precipitation is 100 inches or so a year, it is well distributed, and the temperatures throughout the year are equable.

The old settlers state that originally there was much more herbage on the less active dunes and on the inter-dune flats than now, the reason for its decline being the cattle which had been allowed to roam over the dune country. Apparently under the unrestricted grazing of stock the natural herbage had been tramped out, pulled up or browsed

down, so that the sand movement was becoming greater and greater. It is clear that here, if all grazing is prohibited, the natural herbage can flourish and will accordingly help in fixing the moving sand. Artificial means must also be used, and on a very large scale, before this vast waste of sand can be held in place and reclothed with vegetation.

Conditions are here so favorable for the growth of all plants that it was thought perhaps some direct method of afforestation might give results. It is, of course, well known that the fixation of sand-dunes is a difficult task, and that it usually necessitates the building of a barrier to stop the sand at the sea-wall, in the lee of which sand grasses must first be planted and then trees, and that the planting and maintenance of both grass and trees requires great care to overcome the invasions of wind, sand, and drought. It was known that these expensive methods of dune control, which had been successful in other less favorable sites, would be practicable here, but it was the hope to find short-cut methods of afforestation which might be applicable in this exceptionally favorable locality.

A number of sites were chosen in 1910 for experimentation, where conditions were favorable because of some natural herbage and a minimum amount of sand movement. Funds were not sufficient to go into the experiments except in a small and simple way, but a few plots have been put in each year from 1910 to 1916 and all watched carefully for results. Altogether in the seven seasons about 47 acres have been sown or planted and a variety of species and methods tried. The principal work has been with maritime pine and with willow cuttings.

Willow cuttings of a variety of species were dibbled in the sand on several separate areas at different times. At first most of the plantations promised good results, but none of them proved successful after two or three years. It appears that the cuttings have not been able to survive the sand-blast and summer drought. Possibly with artificial protection (which would probably be too costly to be practicable) a cover might be established. Many cuttings made a foot of growth the first year, but after four years the best of the plots does not show 10 per cent alive. As might be expected, the local willows gave the greatest promise of success, especially the one that is very hardy on the dunes—*Salix hookeriana*.

Maritime pine was the only conifer tried out extensively. It was sown broadcast, seedspotted, and planted. By all three methods it has given entirely satisfactory results, but only where surface conditions were optimum for the dune region. Some of the trees, from both seed-spotted and broadcasted seed sown in 1911, are now three feet high

and very sturdy and stand 1,500 to the acre. The planted trees also are in spots on favorable sites doing well, trees of 1914 planting showing only a small mortality. Maritime pine apparently is adapted to the local climate and does not mind the sand and the wind, but can't stand much drifting or gullying about its roots. Where the surface is stable and the sand-blast is not excessive, a good stocking can be secured by direct seeding or planting. Lodgepole pine (shore pine), the hardiest of the local coastal strip trees, would probably be just as easy to establish as maritime pine and might make fully as good a permanent dune fixative.

The experiments are concluded for the present, because it appears that afforestation, except of the very best of the sand-waste country, will not be possible until an herbaceous cover has first been established to stop the sand movement. When the time does come to undertake the reclaiming of this land on a large scale, it appears that sand-grass planting—a very expensive operation—must precede the planting of the permanent cover of trees in this locality, as has been proved necessary elsewhere.

OSMOTIC PRESSURE AS AN INDEX OF HABITAT

By Barrington Moore

In studies of forest types, or forest associations, we must first know the factors which cause each type, and then the maximum and minimum quantities of these factors which permit the existence of a given type. For example, we know that moisture is one of the factors. What range of moisture conditions, other conditions being equal, will permit the existence of the sugar pine-yellow pine type? What moisture the existence of pure yellow pine?

Although the emphasis should be placed primarily on studies of the manner in which each factor affects the forest, and measurements of the range of each factor in each forest type, nevertheless it is sometimes helpful to find a single phenomenon, which, though its exact workings may not be clearly understood, yet is subject to measurement and serves as an index of the underlying factors. Such an index should never be confused with the causal factors which produce it. It is simply a measure of these causes. The osmotic pressure of cell sap appears to be such an index and to hold out considerable promise of offering a convenient yardstick which will express with reasonable accuracy the moisture conditions of different types.

The importance of the cell sap is due to the fact that "all the activities of the protoplasm, both somatic and germinal, must take place in the environment of the cell solution."[1] The osmotic pressure of the cell solution must exert considerable influence on these activities. Therefore the determination of osmotic pressure of the sap of a species growing under different conditions should throw considerable light on the manner in which those conditions affect the species; also the osmotic pressure which characterizes different species suited to different habitats should serve as a measure of the different habitats.

There are three indirect ways of determining the osmotic pressure of the sap of plants, namely, by the lowering of the freezing point, by vapor pressure, and by the raising of the boiling point. Of these the most used is the first.

[1] Harris, J. A.; Lawrance, J. V., and Gortner, R. A.: "The cryoscopic constants of expressed vegetable saps as related to local environmental conditions in the Arizona deserts." Physiological Researches, Vol. 2, No. 1, pp. 1-49, 1916.

Three noteworthy investigations concerning the freezing-point depression (and consequently the osmotic pressure) of plant tissues in relation to environment have appeared within the last ten months.

Hibbard and Harrington,[2] besides considerable work on methods of determining the freezing-point depression, studied its relation to soil moisture. They maintained, by means of Livingston auto-irrigators, moisture contents of from 11 to 31 per cent of dry weight. They found that corn plants grown under these different moisture conditions had freezing-point depressions of from 1.835° C. to 2.204° C. for the tops and from .492° C. to .995° C. for the roots. This shows that soil moisture has a marked effect on the osmotic pressure of the cell sap.

Harris, Lawrance, and Gortner[3] determined the freezing-point depressions and corresponding osmotic pressures of the leaves of plants growing under different environmental conditions in the neighborhood of the Desert Laboratory at Tucson, Arizona. They found that in general the drier the habitat, the greater the osmotic pressure of the cell sap. It is interesting to notice that the osmotic pressure of the trees and shrubs was greater than that of the dwarf and half shrubs, which in turn had higher pressure than the perennial herbs, and that the winter annuals had the lowest of all. These investigators consider that the freezing-point depression is just as important in ecology as the structural characteristics of the plant upon which ecologists have hitherto so largely depended.

McCool and Millar[4] have greatly improved the method of determining the freezing-point depression and have thrown much light on the relation between the osmotic pressure of cell sap and environmental factors.

Formerly it had been considered necessary to use the juice pressed out of the plant tissue. This is inconvenient because: first, the actual pressing is laborious; second, the liquid has to be cleared as much as possible by centrifugal force; and third, with tough and comparatively dry tissues it is necessary to collect and press large quantities in order to secure enough juice. Furthermore, following Dixon and Atkins,[5] it

[2] Hibbard, R. P., and Harrington, O. E.: "Depression of the freezing point in triturated plant tissues and the magnitude of this depression as related to soil moisture." Physiological Researches, Vol. 1, No. 10, pp. 441-454, 1916.

[3] See note 1 for reference.

[4] McCool, M. M., and Millar, C. E.: "The water content of the soil and the composition and concentration of the soil solution as indicated by the freezing-point lowerings of the roots and tops of plants." Soil Science, Vol. 3, No. 2, pp. 113-138, 1917.

[5] Dixon, H. H., and Atkins, W. R. G.: "Osmotic pressure in plants. I. Method of extracting sap from plant organs." Sci. Proc. Roy. Dublin Soc. N. S., 13, 422-433, 1913.

was considered advantageous to subject the material to a preliminary freezing before extracting the sap. McCool and Millar have found that all this troublesome pressing out of liquid and preliminary freezing is unnecessary, and that practically the same results can be obtained by placing the material directly in the freezing tube and slightly macerating it with a stiff wire flattened and sharpened at one end.

A series of tests using a number of plant tissues showed that the values secured by their method of direct determination and by determinations on extracted liquid were practically the same for the leaves (Table IV, p. 118). With roots the two methods showed differences in some cases, the freezing-point depression being greater with the direct method than with the extracted liquid. This they are as yet unable to explain unless it is due to adsorption by the solid mass in the direct method.

In studying the relation between the osmotic pressure in plant tissues and environmental factors they found, first, that the osmotic pressure changes throughout the day, increasing as the day advances, then dropping off toward evening. It is at a minimum in the early morning. Apparently there is a relation between osmotic pressure on the one hand and photosynthesis and metabolism on the other.

Next they investigated the relation between the osmotic pressure of the cell sap and the concentration of the soil solution in which the plant is growing. Their data (Table XIII, p. 130) "show very strikingly that the concentration of the soil solution is rather closely correlated with the freezing-point lowerings of the roots of plants in contact with it, but the tops of the plants are less sensitive to changes in the soil solution."

In studying the relation of freezing-point lowerings to soil moisture they found that "there is no relation between the water content of the soil and the freezing-point lowerings of the leaves . . . until the critical water content of the soil is reached." The roots, on the other hand, show a close correlation between osmotic pressure of cell sap and soil moisture. Perhaps most significant of all is the indication from their data that the osmotic pressure of the soil solution at the wilting point of the soil is equal to or greater than that of the roots of the plants. This would indeed afford a simple explanation of the wilting coefficient, but is contrary to the work of Shull, who found that roots possessed an osmotic pressure somewhat higher than that of a soil in which the water had been reduced to the wilting coefficient.[6]

[6] Shull, Chas. H.: "Measurement of the surface forces in soils." Botanical Gazette 52: 1-31, 1916. Reviewed by Barrington Moore in Journal of Forestry, Vol. 15, No. 1, 1917.

In applying their method to field conditions McCool and Millar found "that the freezing-point lowerings of the leaves and roots of the same crop growing on different soil classes of high water content do not vary appreciably." This makes the method the more valuable as an index of soil moisture, in that it eliminates the factor of variation in soil fertility.

These investigations on osmotic pressure, as indicated by freezing-point depression, have a direct bearing on forest research, in that they reveal the existence of an index of habitat which may be of great value in silvical studies.

AGRICULTURE AND FORESTRY IN CHINA

We quote the following letter by Prof. Joseph Bailie, of the University of Nanking, which appeared in the *Peking Gazette* for July 16, 1917:

The Central China Famine Relief Committee, in the year 1913, made a grant of $10,000 to establish a colony for famine refugees on the waste lands of northern Anhwei. The writer had already used some of the famine relief funds for developing Purple Mountain, and, from what experience he gained there, represented to the committee that for Mex. $100 an average destitute family could be put upon vacant lands, and in this way a family that was a burden to the State, being settled on land that was useless to the State, could be transformed into healthy citizens that would be an asset to the State. The $10,000 was granted, in order to try this experiment upon 1,000 families.

By March, 1914, a branch colony of our Colonization Association had been organized at Lai-Anhsien, and a grant of 13,000 mou of mountainous lands had been made to that branch association, the land surveyed and mapped, and refugees to the number of 40 families were registered and put on the best parts of these mountains. Last autumn we had 80 families, numbering between 400 and 500 individuals, that had settled on these lands and were self-sustaining.

As there is still over $3,000 of this original $10,000 unused, and as practically all of the land that could be used for agriculture on the original grant had been broken up, we attempted this spring to secure another grant of land on which we could settle 40 or 50 families more.

We had also decided to establish a forest nursery for the colony, which would supply young trees for the colonists to plant on those parts of their own lands that were fit for forestry only, and to plant on those mountains that were not fit for colonizing. The plan is to plant these hills, to be later on a source of revenue to the branch colony. The colonists will be allowed to do the planting, and in this way pay back the money used in supporting them while they were breaking up their lands and getting on to their own feet.

Rev. Charles Best, of the China Inland Mission, who has carried this work on to so successful an issue, and in whose hospitable home the whole entertaining of visitors and organizing and carrying out of the plan has been worked, informed the official, Mr. Wen, that he had in-

vited me to come up and assist in the establishment of this nursery. The magistrate was very pleased, and sent word that he, too, wanted to establish an official nursery, and desired that I take up, when going, as much seed and as many young trees for his nursery as I did for the colonization nursery.

On the day arranged for settling on the site of the nursery, Mr. Wen, as host, went to Ta-an, a temple that had been part of the grant to the branch colony, and which is its administrative center. After riding about and walking over the proposed sites, we shared the good things provided by Mr. Wen. The arrangement arrived at is that we have a joint nursery close into Ta-an, half of the expense to be borne by the official and half by our branch colony, and that Mr. Yu, who has been in charge at Ta-an, be also in charge of the nursery. This, of course, was satisfactory, and even flattering, to us, as it expressed what confidence our friend, the magistrate, put in us. It is also a proof that he considers our work a success.

The next item we considered was the further grant of land for 40 or 50 more families. I should have said that all the local gentry had gathered to meet the official, and to help in disposing of the viands and other discussions and decisions. Though we were so successful in the establishment of a nursery, we made poor progress in securing any consensus of opinion regarding the opening of a new mountain, though there are many lying waste in the vicinity. What was the matter? Well, the real reason was never hinted at by any one in the meeting, but here it is:

When we first started the colony, every colonist that was accepted had to have as guarantor a farmer in the district. The farmers recommended refugees that had come to the place perhaps one or two years previously, and had proved their worth as servants. We also accepted local families that had no lands. Everything went on well till the harvest time came, and as these landless poor were now harvesting their own crops there was a dearth of labor, and wages jumped to double the price they had been before we started the colony.

People from outside, however, gradually filtered in again, but wages never have come down again to the sweat-system level they were at before our colony was planted there. This, of course, is the very object for which the colonization was established, and if we could only be successful in getting families on to all the vacant lands in China human flesh and blood would not be cheaper than horse or mule flesh and blood, as it now is. We would see conveyances on Shanghai streets hauled no longer by human beings, but by animals, and the ricksha-coolie problem

would no longer be a problem, as there would be no ricksha-coolie. But how, then, would be ever be able to get around in Shanghai? Carriages and autos are so dear! Well, either walk or go home and live honest lives. Just think of asking a man in San Francisco or Chicago to haul you for an hour in a ricksha for a dime!

To return to Lai An-hsien, the reason why no petition was forthcoming from the landed gentry for an extension of the land for our colony was that they found out by experience two facts: First, that wages were raised by colonization; and, second, that their lands, which they have been renting to the poor to farm, giving the farmer only five-tenths of the crops and taking the other five-tenths as rent (yes, sometimes even six-tenths of the crop is taken as rent), they found out that these lands were not so valuable to them when they had to pay wages to have them cultivated as they were when they could squeeze half the produce from a tenant farmer.

I once went the rounds with a landlord among his tenants as he was assessing how much grain should be paid from each field every farmer had, and I saw how the thing was worked out. The landowner took no chances. He said this field will produce ten bushels, that six, and so on, and the farmer might protest as he liked, but he had to produce the five or three bushels for the landlord after harvest. No arbitrators! The farmer and his wife and children work day and night, live in huts not fit for pigs, and are lucky if they have rags as covering. Rarely are there schools, and what there are, are not for the children of the farmers, but for those of their oppressors. So long as the gentry are allowed to keep the public lands vacant, in order that their own cattle may graze over those lands to prevent their slaves (for these tenant farmers are slaves) from running away from tilling their estates, so long will the situation of coolie labor remain with us. Can we not shame the landlords in some way into desiring to elevate their country in the eyes of foreigners? That isn't the plan. Shake the land out of their grip and throw it open to all. Establish rural credits banks, and there won't be any need of colonization associations or any other form of charity. Just give the farmers fair play, and we'll see a new China soon, for the farmers are 85 per cent of the nation.

REVIEWS

French Forests and Forestry. By T. S. Woolsey, Jr. John Wiley & Sons, New York. 1917. Pp. 238.

The title of this volume, at least the cover title, is misleading in rousing the expectation that a general discussion of the forest practice of France is intended, when in fact forest conditions and practice in three dependencies are only treated, namely, those of Tunisia, Algeria, and Corsica. The author having personally visited these countries, being familiar with the language, and a world-wide traveler, his account assumes an authoritative character.

The author has written the book because he considers that the French methods applied in these countries are also *directly* applicable in the United States. He thinks so because they are not intensive, and because they rely on natural regeneration. But we are skeptical in this respect. Whatever similarities in natural conditions may be found in these countries permitting similar silvicultural practice, economic, market, transportation, and populational conditions are so entirely dissimilar that practically we cannot reasonably follow the example.

This does not detract, however, from the usefulness of the study of the conditions and practices in these countries for the *indirect* value in working out our own policies and practices. In the introduction the author seems to consider it rather a merit that he has avoided comparisons between French and American methods, but just here the interest in the book could have been usefully intensified and, indeed, the author occasionally does expand in that direction. The accentuation of the natural renegeration methods—which are often practiced, not because they are the best, but because considerations of present pocket interest do not permit more intensive methods—is perhaps overdone. At least the countries described require largely the artificial reforestation of difficult and arid sites under climates somewhat analogous to our southwestern territories, where natural regeneration is of doubtful success or impracticable.

A detail description of general and forest conditions, administrative organization and legislation, forest management, forest protection, forest policies, and silvicultural methods in use are given for each country, but for the comfort of him who does not want the detail, the

author opens the volume with a summary on ten pages, rather too brief to leave a useful result on the reader's mind.

In Tunisia, where the French instituted a forest service in 1883, cork oak forests (250,000 acres, with 10 million trees) are the valuable property, located in the north. These are to some extent intensively managed, in orchard fashion, with a 3-year return period, while the less valuable Aleppo pine and holm oak is cut for fuel or maintained as cover against erosion and as windbreaks.

On the central plateau occupied by "ruins of former forest," in which the pine is the main species, the forest cover is maintained entirely for protective purposes; and the southern zone is practically forestless. Here, of course, extensive management is forced and keeping—if possible—fires out seems to be the only policy. When it is stated that in the budget for the administration of the 1.9 million acres of forest in all 7 supervisors and 126 of lower grade (half of them natives) are provided, a judgment as to the efficiency of the protection may be had. Working plans are unknown and "not required." The only restriction upon ordinary grazing, which is permitted at a price, is after a conflagration, when for six years the area is closed. Incendiarism is still the chief cause of fire. Nothing special is attempted in fire protection except fire lines in the cork-oak forests, which "only brushed out are almost always ineffective, unless all trees and stems are removed." But this is very expensive. The practice of fire-line construction is detailed. As far as we can see, nothing is to be learned from Tunisia for direct application in fire protection with us.

Considerable attention has been given to fixation of sand-dunes and shifting sands for the protection of oases. Planting as far as possible is avoided, and a seed-spot method is preferred before resorting to planting, but "thus far the scale of operations has been so small (in 35 years!) that forestation in Tunisia may still be considered as experimental in character."

This is different in Algiers, where a special reforestation service is installed. But then Algeria has been twice as long, or 60 years, under French domination. The administrative organization has been vacillating and varied from time to time, and is now, since 1896, with final improvements in 1906, directly under the Governor General, except that the technical officers are loaned by the home Secretary of Agriculture, a curious condition which is said to work better than any previous arrangement. There are 66 such officers, besides over 1,000 guards and rangers, for a State forest area of around 5 million (out of a total of 7 million) acres, divided into three conservations. More than half this

area has been burned over one or more times during the past 40 years, giving rise to brush lands or "maquis." Not exactly a picture of well-preserved forest wealth! And in spite of the expensive system of fire lines extensive damage from fires continues.

As in Tunisia, the cork oak, which furnished three-quarters of the State forest income of $740,000, with a few other evergreen oaks and the Aleppo pine, are the two most important species, and the pine is also most widely distributed. Cedar and juniper and maritime pine, of conifers, and a number of hardwoods occur. It is rather misleading to apply the term selection system to the cork-oak orchard management, which, to be sure, is based on a diameter limit below which the peeling is not profitable, but the cork is peeled four to six times before trees lose their producing capacity and are then cut for tannin and fuel.

The Aleppo pine, which sometimes occurs in pure stand, is experimentally tapped for resin. It seems that such turpentine forest is to be regenerated by shelterwood (not selection) method. A seed-tree method in groups is used with other species and coppicing in fuel oak woods. A special method, *culée noire,* is applied in overmature stands, when the stump is removed down to a depth of 20 to 24 inches, freeing large roots which produce vigorous shoots and suckers.

Working plans, it is stated, have so far not been necessary, but the outlines of usual plans are given, which are similar to the European; to call the records of administration, as is done on page 72, an "admirable substitute for the formal European working plan" is, to be sure, mixing up plan and its results.

Planting, or rather sowing, is done only where there is not the slightest chance for natural reproduction. Although there is a chief of reforestation, he acts only as an adviser and his views of the best method he has no power to enforce; hence considerable variation in practice is found. The planting is done in winter, after the rains have commenced; sowing in seed spots or furrows is preferred, but is only successful when thorough preparation of the soil is made, the difficulty in shipping plant material and probably of growing it being the main objection to planting, except with ball where necessary. As arid and difficult sites are involved, the author considers the study of methods here employed valuable to our foresters. But are the climates of the same character?

A lengthy discussion on fire lines leads the author to conclude that they are necessary; but well cleared *narrow* lines are more practical than expensive *wide* lines.

Since "local conditions are in many respects similar to the western United States," (?) the entire Algerian forest code is translated, occupying 60 pages.

We are inclined to think that climatically and commercially or industrially the third of the French colonies, Corsica, finds closer counterparts in the United States, although the population, difficult enough in the other two colonies, is more unruly than anywhere, which makes protection against fire and trespass, especially grazing of sheep and goats, most difficult. So difficult indeed is it to apply the grazing regulations that they are in fact not applied in order to avoid incendiarism, and silvicultural methods are devised not for their silvicultural value, but to meet this difficulty of grazing and fire.

The character of the people—not Frenchmen—with which the administration has to deal may be judged from the statement that in 1911 almost 600 trespass cases were before the courts and more than half were acquitted.

Corsica has been under French domination 150 years (since 1768, when they captured the island, not 1759, as stated, when the Genoese ceded their rights to it), but an attempt at technical forest administration dates back not quite 100 years (1824).

Of the 3,400 square miles, in 1878 not quite 25 per cent, or half a million acres, were officially reported under forest; but by 1912 the figure, if not the forest, had shrunk to 430,000 acres, two-thirds State forest, but this figure is by nearly 100,000 acres too large if really wooded condition is meant, reducing the forest per cent to 16. A mountain range occupies the center of the island, the lower slopes of which, as far as not field or pasture, being occupied by *maquis* (chaparral and mismanaged hardwoods) and some cork and other oaks; maritime pine and chestnut are typical of the elevations up to 3,000, and the alpine zone up to 6,000 feet is composed of Corsican pine, with beech and fir. The pines occupy the largest area, ·67 per cent in the State forests and nearly 50 per cent on the average, the Corsican pine, being by far the most important, growing to a height of 150 feet and more and sometimes over 6 feet in diameter.

All details of modern fire protection are missing; only partial brush disposal and fire lines brushed out, wider and narrow ones, contrary to the Algerian experience, the wider lines being favored except for the expense.

The fear of larger conflagrations has also been the reason that for the light-needing Corsican pine the sacrifice is brought of using the selection system to avoid the large even-aged areas resulting from the shelterwood system used before. While under this system the areas need not have been so large, other considerations, namely, the need of opening up the country by roads, required that large enough and long-term

enough sales be made to justify contractors in making the expenditure on permanent roads.

That this expenditure should have been made by the owner—the government—as an improvement of its property, and not at the expense of the silvicultural system, did not apparently occur to the authorities.

Artificial reforestation has hardly been practiced and the two plantations of extent (sowing in seed spots) which are mentioned have not been a success, through ignorance in one case.

We have not been able to see much that is directly applicable to our own problems in the administration, management, or silviculture of the French colonies, nor indeed do these methods seem to have produced unqualified success; but we have given a sufficient insight into the contents of the volume to show that the accounts are comprehensive and worth studying for the indirect benefit that must come from its perusal.

There are some minor points of criticism which we offer for the benefit of the author in bringing out a second edition.

Although the author in the Introduction very properly proposes in giving equivalents of French measure to merely approximate the American measures, he repeatedly gives equivalents to the second and third and even fourth decimal, or otherwise unnecessarily exact (see pages 8, 113, 115); and in several places the equivalents are faulty, *e. g.*, page 43, 1.5 meter = 7 yards; page 53, 4 hectares = 10 acres and 2 hectares = 6 acres; page 56, 40 hectares = 88 acres; page 119, 20 meters = 666 feet. On page 115, both holm oak and vert oak are named *Q. ilex*, probably by oversight. On page 119, the American Civil War is made responsible for high prices of naval stores in the years 1856 and 1872. On pages 52 and 53, a number of useless references without pages are noted, as *Id.* instead of *Ibid.*

B. E. F.

British Forestry; Its Present Position and Outlook after the War. By Edward Percy Stebbing. John Murray, London, 1916. Pp. 258, 12 plates.

Professor Stebbing, of the University of Edinborough, has brought the dependence of Great Britain on timber imports into strong relief in the book under review. The demand for wood in Great Britain has greatly increased since the outbreak of the war. Due to the submarine menace and the need for all available bottoms for other shipping, importations, however, have been reduced, even in this time of greater need. The falling off of importations and the increased need has led

to heavier fellings, which are making serious inroads into the available forest capital of the home forests. The book includes an introduction and four parts. The former takes Evelyn's *Sylva* as a text and brings it down to present times. The *Sylva* appeared in 1664 and immediate and speedy planting was the chief note that it carried to the British nation. If Evelyn's warning of two and a half centuries ago and that of British foresters of the past two centuries had been better heeded during the past century, the closing paragraph in the introduction to Stebbing's book would be vastly different. This paragraph reads as follows:

"This planting question should no longer be delayed. Our waste lands should no longer be left unproductive. Is the nation going to see to it that this work is carried out? And may the nation hope that that Great Britain Society which soon after its inauguration, as I implicitly believe and as Evelyn put it, awoke in the country the spirit for planting and thereby saved us from invasion in the days of Napoleon, will come to its aid once again and by its powerful support help us to secure that area of home woods which present-day necessities demand, which a full utilization of our national resources and the campaign for thrift in all departments of life equally demand, and which our posterity is likely to so sorely need."

The author shows in a convincing way in Part I what forestry means to Great Britain. He states that there are 10,400,000 acres of what has been termed idle land in Great Britain, the most of which is suitable for forest growth. There are also 16,500,000 acres of mountain and heath lands, part of which are capable of afforestation. The author states that although before the war Great Britain took approximately half of the world's total imports of forest products, the war's destruction must necessarily react on the forest supplies available in the countries from which she has heretofore drawn her forest products. For many years after the war there will be keen competition for wood on the part of all nations now engaged in it. Great Britain, he states, will be helpless in the timber market because she will have no supplies of her own which if carefully husbanded would have enabled her to tide over the first period of reconstruction.

The question raised by the author is, How is Great Britain going to set about the afforestation of her large waste areas on a scale commensurate with her necessities, in order that succeeding generations may not be left entirely at the mercy of foreign countries?

A brief survey is made of the past history of the afforestation question in Great Britain and the results of forestation as a paying propo-

sition are pointed out. The author states that all that appears to be wanting is a plan of campaign and a favorable hearing from the government. He is convinced that a great national planting scheme must be undertaken and carried out by the government. It is impossible to forecast the future, but the demand for timber most likely will be greater and the prices higher than at present. It rests with this generation to say whether they will leave their posterity to face an even worse position than that of today. He believes the only safe course to follow is to undertake at once the planting up of such available waste lands as are obviously capable of growing a good, marketable crop of timber.

The following methods of national afforestation are considered by the author, any one of which should produce satisfactory results, given a correct choice of method for a particular locality and efficient management:

(*a*) The lease and afforestation of waste lands by government, the proprietor sharing in the expenses and profits.

(*b*) The lease and afforestation of waste lands by government.

(*c*) The purchase and afforestation of waste lands by government.

Part I closes with a discussion of finance, planting methods, and available labor.

Part II discusses the British timber supplies and the forests of Russia. The writer contends that after the war Great Britain must turn to Russia, even more than at present, for the greater part of her major timber supplies. Furthermore, he insists that instead of securing the needed supplies from hand-to-mouth, the policy of Great Britain should be to make definite arrangements by which timber supplies during the next 40 or 50 years may be insured. In 1913 Great Britain received 35 per cent of her timber imports from Russia, but after the war Russia will be about the only country with forest resources of timber that will be available and reasonable in price. The author suggests the possible leasing by Great Britain of large areas of Russian timber.

Part III is concerned with present timber supplies and the war and Part IV with the future employment of women in forestry, due to the great loss of men in the war.

The book as a whole is a stirring and convincing argument for better forestry in Great Britain.

J. W. T.

Action des Engrais sur les végétaux ligneux (*The Effect of Fertilizers on Woody Plants*). By Lucien Chancerel.*

In spite of its evident importance, the study of the effect of fertilizers on woody plants has been neglected for a long time. At shorter or longer intervals experiments have been recommended. Some experiments were even carried on, notably in France, by Chevandier, about 1850. But little attention was paid to the knowledge gained, and the experiments, not continued, were soon forgotten.

For several years the question has again presented itself for determination.

It is to the Belgian foresters that belongs the honor of having again brought up the subject. In Belgium, as elsewhere, the experiments were carried on first and chiefly in the nurseries. Huberty and Delville devoted themselves to the work and made known the results; but there were also some tests made in the forest, notably in the Campine. Huberty enumerated in 1901, in the "Bulletin de la Société centrale forestiere de Belgique," those which were carried on by Naets on the estate of Count Merode-Westerloo.[1] In 1903-1904 Halleux gave a detailed abstract of the results obtained in the afforestation of the Campine. Finally, in 1908 Haumont[2] gave an account of experiments carried on with broad-leaved trees in the State forest of Dilserbrosch.

In Germany the action of fertilizers on woody plants has been studied, in later years, by a number of people, notably by Schwappach, of the Eberswalde Forest School, and Goetting, of the Agricultural Institute of Luedinghausen; by von Daacke and Hallbauer, at Metz; Scott-Preston, at Dobrilugk; Ramm, at Calmbach; Wendt, at Friedewald; Schalk, at Rehau; Reichart, at Freising . . . and finally, by Ramann and Felber, at Stassfurt, and Giersberg,[3] at Berlin.

In Luxemburg, Beiler[4] and Theis made about the same tests.

The question is one of importance in Austria and in Denmark.

In France, Thézard ascertained that fertilizers, applied in an oak forest in Eure, had caused an increase both in acorn production and in growth of wood. Experiments were carried on by Henry in the State forest of Chinon. At the research station of the forest school of Nancy, Cuif studied the action of various fertilizers on plants raised in

* "Revue des Eaux et Forêts," Series 4, Vol. VIII.

[1] J. Huberty: Emploi des engrais chimiques en culture forestiere. Bruxelles, 1901.

[2] L. Haumont: Emploi des engrais chimiques en sylviculture. Bruxelles, 1908.

[3] Dr. Giersberg: Kunstliche Dungung im forstlichen Betriebe. 3d edition. Berlin, 1905.

[4] Prof. J. P. Beiler: Kunstdüngun im forstlichen Betriebe. Berlin, 1907.

the sandstones of the Vosges. Mathey gave an account, in the September 1909 number of the "Bulletin de la Societe forestiere de Franche-Comte et Belfort," of tests made on the calcareous wastes of the Burgundian Hills. Upon information furnished by Professor Schribaux, of the National Institute of Agriculture, I myself carried on some experiments in the Ermenonville State forest and in the swamps of Bresles.

But, it must be admitted, the results obtained up to the present time are not very conclusive. In most of the tests, carried on principally in nurseries, the various fertilizers have not been studied in a sufficiently methodical manner to learn the effect of each one.

The experiments of Lucien Chancerel have been carried on in a more scientific manner. The author in his recent work, "l'Action des Engrais sur les vegetaux ligneux," has given the results of his investigations, with comments upon them. He has taken a great step in this important question, and in so doing has rendered a great service to science and to silviculture.

Attached to the "Administration des Eaux et Forêts," having proved very advanced scientific studies, and having much leisure at his disposal, Chancerel was perfectly qualified to undertake and carry to a conclusion research work which demanded extensive knowledge, extreme attention to the minutest details, and much time.

After having demonstrated the importance of the question—above all, at a time when reforestation is a subject of great interest—and having shown its actual status in France, at least, for most of the experiments made in foreign countries are not mentioned, those referred to by me at the beginning of this article being ones of which I have personal knowledge, the author enumerates the fertilizers to use and mentions those which were used in these experiments. They are: Among the organic fertilizers, stable manure and dried blood; among the mineral fertilizers, nitrate of soda and sulphate of ammonia for the nitrogeneous fertilizers; superphosphate of lime, phosphate of lime, and the scoria for the phosphate fertilizers; sulphate, carbonate, and chloride of potassium for the potash fertilizers; sulphate of iron, and, in addition, sulphate of manganese.

Chancerel acquaints us with the action which took place when experiments were carried on at the same time for the principal forest plants, with seedlings, transplants, transplanting shoots, and cuttings, in distilled water, artificial soil, and natural soil.

The experiments in distilled water were carried on in wide-mouthed glass vases covered with black paper. They were carried on with seed-

lings of black alder, pedunculate oak, common ash, horn-beam, silver fir, maritime pine, Scotch pine, and Austrian pine; with shoots from twigs and roots of oak, birch, and aspen; on cuttings of aspen, osier willow, oleander, and grape.

Experiments in artificial soil were made either in pots *en biscuit de Sevres,* washed in hydrochloric acid, calcined, then filled with fine sand from the Loire equally washed in hydrochloric acid and calcined, or on experimental areas of 1 square meter, where the natural soil had been replaced, to a depth of 1 meter, by fine sand previously washed. Tests were conducted with seedlings of pedunculate oak, beech, fir, Scotch pine, black and maritime pine; with transplants of oak, alder, birch, fir, and Corsican pine, and with cuttings of osier willow.

The experiments in natural soil took place in unmanured gardens, either by putting the fertilizers at the foot of the trees and burying them lightly or by putting them in contact with the seed. Results were obtained from seedlings of pedunculate oak, beech, Scotch pine, black pine, and maritime pine; from transplants of oak, birch, alder, Scotch pine, Corsican pine, and black pine; from cuttings of black poplar and osier willow. Besides, experiments were carried on in the Forest of Orleans, in vacant spaces, in coppice cut the preceding year, in a soil representing the medium of those of the forest, tests being conducted with pedunculate oak, birch, and Scotch pine.

Each of these three series of experiments is the subject of a special chapter, in which Chancerel gives the details and the results of each experiment; then, in conclusion, the résumé of observations made.

In the chapters which follow the author has examined and explained the most important anatomical modifications produced on woody plants by the action of different minerals.

It will suffice to transcribe his principal conclusions:

The mineral nitrogenous fertilizers, nitrate of soda, sulphate of ammonia, are dangerous to handle in silviculture, in all cases.

Fertilizers of potash, sulphate, carbonate, chloride of potash, and kainite are retarders of woody growth. They can, however, render great service in one case, in silviculture; when one wishes to make a seed-cutting and to obtain a rapid fruiting of the trees.

Calcium fertilizers are the true accelerators of woody vegetation. Among them must be placed, in the first rank, sulphate of calcium, then lime and carbonate of calcium.

To these should be added—in small quantities, the mineral phosphate fertilizers—phosphates of calcium, superphosphates, and scorias, which gave fine results with the broad-leaved species, as well as with the conifers.

Finally, sulphate of iron applied in very small quantities to the plant past the seedling stage, put on the surface and not in contact with the roots, will stimulate woody growth. . . .

The importance of these conclusions is sufficient to prove the worth of the work of Chancerel.

Some of the results obtained are surprising. Even though the beneficent rôle of calcium fertilizers was known (Giersberg demonstrated it for beech, and quite recently Cuif treated the subject in a more general way) and the good effect of phosphate fertilizers was generally admitted, the disadvantages were not guessed of using in silviculture nitrogenous and potash fertilizers, the majority of writers on the subject up to the present time having recommended their use; also one is surprised to learn that maritime pine, known as a calcifugous species, flourishes in an artificial soil saturated with calcium.

Chancerel's book is very well arranged and perfectly presented. It is illustrated by 52 well-chosen figures, of which about 20 are photographs of the plants, shoots, or slips in experiments, and 27 represent cuts of wood showing the principal anatomical modifications as the result of the mineral application.

The National Society of Agriculture, in its formal public meeting of January 12, 1910, bestowed a gold medal on Chancerel for his remarkable work on "The Action of Fertilizers on Woody Plants."

All those who will read the book which I have just analyzed will certainly acknowledge that this high recompense was well deserved by the learned and conscientious author of a work of such importance and merit.

L. PARDÉ.

(Translated by Mathilde Ammen.)

1. *R. Hickel—Regarding Scotch Pine. Value of French Seed and Plants.* (A propos du pin sylvestre. Valeur des graines et des plants français.)*

2. *Ph. Guinier—The Choice of Seed in Forest Culture.* (Le choix des semences en culture forestière.)*

The question of the influence of the origin of seed on the quality of the tree is of great interest at the present time. It has been treated during the past few years by numerous authors, notably by Cieslar in Austria, by Mayr and Schott in Germany, by Engler in Switzerland, and by Huberty in Belgium. In spite of that it is far from being solved.

* "Revue des Eaux et Forêts," Series 4, Vol. VIII.

It is, I think—of all the subjects which were submitted to the section of silviculture at the International Congress of Agriculture at Vienna in 1906—the only one on which no conclusion was reached.

In their prospectuses, where the commercial idea dominates forcibly, dealers frequently express opinions which are too positive and which are usually based on experiments the results of which, insufficiently controlled, are contestable. Thus, very recently, in the case of Scotch pine, a German house stated that seed of French origin was of an inferior quality. A seed dealer in our country replied at once that the seed received from Germany gave very bad results. These two statements are manifestly exaggerations.

To speak only on the part of France, I was able to see, at the end of the excursions of the "Congrès de l'Arbre et de l'Eau," in Limousin, in 1908 and 1909—particularly at the home of de Belinay at Ligniac—plantations of beautiful Scotch pine trees, derived from seed gathered in the mountains of the Central Plateau, and I surveyed at the home of Dupic at Gentioux (Creuse), and of d'Ussel and de Belinay at Ligniac (Corrèze), magnificent stands of the same species, where the seed was bought in Germany.

R. Hickel, instructor of silviculture at the National Agricultural School of Grignon, has written a very painstaking article in regard to Scotch pine. In this article the author begins by sketching the geographical distribution of this species, pointing out that it is only found indigenous in France in the mountains. He finally gives the results of experiments carried on with the view to ascertaining whether certain particular characteristics of different varieties are hereditary or not.

Hickel investigates the geographical distribution of Scotch pine, its horizontal optimum (in latitude) and its vertical optimum (in altitude). If the horizontal optimum be reached in Eastern Prussia, Poland, Courlande, and Livonia, regions where the so-called Riga pine grows, the vertical optimum would be, according to him, in the mountains of Forey and the surrounding regions (excepting, however, the provinces of Cangal and Puy-de-Dome). There pines can be seen which, comparable to those of Riga, show perfectly straight, cylindrical trunks, with branches regularly disposed and relatively short, all characteristics which contrast with those presented by the trees derived from seed from Germany or from Haguenau.

Hickel mentions particularly a plantation of old Scotch pines at Giat, on the boundary of the provinces of Puy-de-Dome and of Creuse, evidently indigenous, in his opinion, and which differs singularly from all the others around, obtained more recently from imported seed. The

inhabitants of the country assert, moreover, that the pines of Giat furnish a wood especially valued in that region.

Later remarking that pine seed said to have come from Auvergne—though the name is not a very exact one, judging by what has previously been said—has always given, according to the acknowledgment even of German merchants, a remarkably high rate of germination, Hickel concludes in affirming the superiority of the so-called pines of Auvergne over those of Germany.

This conclusion seems to me at least premature, due to the fact that the origin of the seed used in the plantations visited by Hickel was not exactly determined, and also that there have yet, to my knowledge, been no comparative tests made which yielded closely controlled results.

Ph. Guinier, who gives the course of lectures in botany at the "National School of Forests and Streams," in the very remarkable address which he made July 19, 1909, before the general assembly of the Society of Forestry of Franche-Comté-et-Belfort, did not push his studies or his conclusions as far as that.

Examining first the question of the site variations of the principal forest species, he gives an account of the experiments which were carried on with Scotch pine in France by de Vilmorin in the province of Barres; in Germany by von Sivert, Mayr, and Schott; in Austria by Cieslar, and in Switzerland by Engler; on spruce and larch by Cieslar and Engler, and on fir and sycamore-maple by Engler.

Guinier also devotes some pages to individual variations, citing the case of the pedunculate pyramidal oak, that of the twisted beech of Verzy, and that of the June oak.

In his lecture Guinier proposed to put the question before the public, with the idea of indicating its importance much more than of solving it, because "his study," he wrote, "is not yet sufficiently advanced."

I am entirely of Guinier's opinion, and, like him, I ask, that to solve the problem in which he is interested, "comparative and, above all, sufficiently prolonged experiments" be made.

All the readers of the "Revue des Eaux et Forêts" who are interested in the important question of the influence of the source of seed on the quality of the trees derived from them will certainly read with the greatest profit Hickel's article, which appeared in the "Journal d'Agriculture pratique," and the text of Guinier's address published in the "Bulletin de la Société forestière de Franche-Comté et Belfort" and in the "Annales de la Science agronomique."

BEAUVAIS, *January, 1910.* L. PARDÉ.

(Translated by Mathilde Ammen.)

Present and Possible Products from Canadian Woods. By J. S. Bates. 1917. Pp. 16.

This is a paper read before the Canadian Society of Civil Engineers by the Superintendent of the Forest Products Laboratories—a rapid survey of the subject of utilization of wood and its derivatives.

The discussion is based on a chart which enumerates the various uses, and as it is perhaps the most complete and classified list, we reproduce it in full. The italicized items are materials now manufactured in Canada.

A. Wood Used as Such—

- Rough: Firewood, cross-ties, mine timbers, poles, piling, fence rails.
- Rough sawn: Lumber, structural timbers.
- Rough manufactured: Shingles, laths, outside finish, boxes and crates, barrels, ship and boat timbers, tanks and silos, veneer, excelsior, wood paving blocks, water pipe, *wood flour, wood wool.*
- Specially manufactured: Sash and doors, furniture and fixtures, flooring and inside finish, agricultural implements, vehicles and supplies, railway cars, musical and scientific instruments, coffins and caskets, handles, woodenware, patterns, laundry appliances, machine construction, refrigerators, sporting goods, matches and tooth picks, pulleys and conveyors, toys and novelties, trunks and valises, dowels and pegs, shuttles, spools and bobbins, plumbers' woodwork, brushes, picture frames and mouldings, shade and map rollers, bungs and faucets, sewing machines, tobacco boxes, boot and shoe findings.
- By-products: Logging waste—Tops, stumps, branches, cull logs, leaves, twigs, roots.
  - Sawmill waste—Slabs, edgings, trimmings, sawdust, bark, culls.
  - Manufacturing waste—Seasoning waste, shaping waste, sawdust, shavings, culls.

B. Pulp and Paper Industry—

- Groundwood process: Groundwood pulp—Wall board, fiberware, pie plates.
  - Mixed with sulphite—Newsprint paper, hanging paper, wrapping paper, book paper, container board, liners, posters.
- Sulphite process: Sulphite pulp—Print paper, wrapping paper, writing paper, book paper, bag paper, tissue paper, paper towelling, wax paper, greaseproof paper, imitation parchment, plastics, *vulcanized fiber, surgical cotton, viscose, gum cotton, cellulose acetate, filter mass.*
  - Waste sulphite liquor—*Binders, tannins, ethyl alcohol, cattle food, fuel, distillation products, fertilizer, mordants.*
- Sulphate process: Kraft pulp—Wrapping paper, *paper twine, ropes, bagging, carpets, cloth, belting, conduits, imitation leather.*
  - Sulphate pulp—*Wrapping paper, writing paper, book paper.*
  - Spent liquor—Rosin oil, turpentine, *rosin soap, methyl alcohol, acetone, acetic acid, oxalic acid, higher oils.*
- Soda process: Soda pulp—Book paper, litho paper, writing paper, blotting paper.
  - Spent liquor—*Methyl alcohol, acetone, acetic acid, higher oils.*

C. Distillation Industries—

Destructive (hardwoods): Crude wood alcohol—Methyl acetone, methyl alcohol—Formaldehyde.

Acetate of lime { Acetic acid—Acetic anhydride, methyl acetate. Acetone, methyl ethyl ketone, white ketone oil, yellow ketone oil, ketone residue.

Charcoal, gas, hardwood tar, creosote oils, beechwood creosote.

Destructive (resinous woods): *Turpentine, pine oil, light oil, pine tar oil, pitch, charcoal, gas, methyl alcohol, acetone of lime.*

Producers (wood waste): *Producer gas.*

Steam and solvent (resinous woods): *Turpentine, pine oil, rosin extracted wood.*

Steam (essential oils): Cedar oil, spruce oil, *hemlock oil, pine needle oil, birch oil.*

D. Minor Industries—

Direct from trees: Maple sap—Maple syrup, maple sugar, *malic acid.*
Gums—Canada balsam, spruce gum.
Fruits, nuts, flowers.
Naval stores—*Turpentine, rosin.*

Extraction with solvents: Water (bark and wood)—Tanning solutions, tanning extracts.
Water (wood ashes)—Potash.
Volatile solvents (resinous woods)—*Turpentine, pine oil, rosin, extracted wood.*
Alkalies (resinous woods)—*Turpentine, pine oil, rosin soap, paper pulp.*
Water (dyewoods—Black *oak extract, butternut extract, walnut extract, Canadian sumac extract.*
Water (western larch)—*Galactose, mucic acid.*

Hydrolysis (wood waste): *Ethyl alcohol, cattle food.*

Alkali fusion (wood waste): *Oxalic acid.*

In the body of the paper statistics of Canadian wood manufactures are given for the different materials and the woods employed.

The annual statistics rounded off may be compiled into the following enumeration:

Total forest products (primary)	$175,000,000
Export of wood products	100,000,000
Capital (4,999 establishments) in timber, lumber, and re-manufactures	260,000,000
Capital (773 establishments) in paper and printing trades	63,000,000
Railway cross-ties, 20,000,000	9,000,000
Round mine timber, 53,000,000 linear feet	524,000
Sawn mine timber, 23,000,000 feet b. m	304,000
Poles, 283,000	660,000
Lumber (3,239 mills), 3,842, 676,000 feet b. m	62,000,000
Shingles, 3,000,000,000	6,000,000
Laths, 800,000,000	2,000,000
Pulpwood, wood pulp, and paper exports (90 mills)	45,000,000
Pulpwood consumption, 1,406,000 cords	9,400,000
Pulpwood exports, 950,000 cords	9,300,000

The pulp and paper industry, the distillation industry, and chemical derivatives come in for an interesting explanatory exposé. We learn that 89 per cent of the newsprint paper is available for export, mainly to the United States. The waste liquors from sulphite and sulphate and soda processes are capable of useful application in several directions, but seem not yet practically used in Canada, except that one mill is reported as recovering so-called rosin oil from the sulphate liquor. Eleven plants in Ontario and Quebec are distilling hardwoods, not only at the rate of 500 cords per day, but refine and produce derived products, and exporting most of the calcium carbide, acetate of lime, and methyl alcohol, the acetate having just now a tremendous demand for acetone in the manufacture of cordite, the most important explosive. Canada has developed new chemical processes on a commercial basis for this use. The creosote oils resulting in the distillation have been found suitable for the flotation process used in recovering metals from silver and gold ores. For this use the pine oil from the distillation of softwoods is also applicable, which is as yet undeveloped in Canada.

Of minor industries only a few are carried on in Canada. The annual maple-sugar product represents over two million dollars in value, and a by-product of this industry, calcium bi-malate, is found superior to cream of tartar or other acids used in baking powders.

Canada balsam and spruce gum are well-known products.

The production of ethyl alcohol from wood wastes, which two large plants in the United States operate, is as yet not practically established in Canada.

B. E. F.

Increased Yield of Turpentine and Rosin from Double Chipping. By A. W. Schorger and R. L. Pettigrew. Bulletin 567, U. S. Department of Agriculture, Washington, D. C. 1917. Pp. 9.

The fact that the yield of naval stores from the southern yellow pines can be increased by more frequent chipping is again brought out in a timely manner in this publication. Field experiments made by the Forest Service on the holdings of a lumber company at Columbia, Miss., included the chipping of 16,141 faces during the greater part of one season. A portion of the area was chipped by standard methods as a basis for comparison and narrow and double chipping was practiced on the remainder. Through the effect of double chipping (which consists in chipping twice a week, cutting a narrower streak) the yield of turpentine was increased 31 per cent and the rosin 36 per cent, with a net

gain over standard methods of $450 per crop per season. Narrow chipping once a week reduced the yield of turpentine and rosin 17.5 per cent, as compared with standard chipping. As the timber available for turpentine orcharding is decreasing very rapidly, more intensive methods of orcharding are becoming imperative. According to the authors, the main problem in applying the double chipping system is to find a sufficient number of chippers, due to prevailing labor conditions.

B. L. G.

The Mineral Industries of the United States—Fertilizers: An Interpretation of the Situation in the United States. By J. E. Pogue. Bulletin 102, Part 2, United States National Museum. Washington, D. C. 1917. Pp. 22.

This is an excellent brief discussion of the needs of the fertilizer situation, present and future, in simple language, explaining the functions and actions of the most important fertilizers and the sources of supply, the object being to stimulate government activity in regulating their use.

It appears that while potash could be and has been secured from wood ashes, this source of supply is too insignificant.

The Development of Forest Law in America. By J. P. Kinney. John Wiley & Sons. New York. 1917. Pp. 254; xxi.

This is a sequel to the author's volume, lately published, on *The Essentials of American Timber Law,* which we reviewed on page 254 of this volume of the JOURNAL, and it may be termed a by-product of the work on the former volume, being the historical development of the forestry movement in the United States as expressed in legal enactments.

While the author is naturally dealing only or mainly with facts, he knows how to present them interestingly in their relationship.

The construction of the book is based on a time and subject division in seven chapters; the time division refers to legislation had before 1900 and that of the twentieth century to date; the subject-matter refers to forest administration laws, forest-fire control, encouragement of private and municipal forests, Federal forest protection and administration; and one chapter summarizes the progress in forest legislation on brief twenty pages.

This last, Chapter VI, is naturally of most interest to the casual reader. It is divided into eight divisions, each with three to eight para-

graph headings. The division headings clearly state the contents: Under Systems of Administration, the States working under each of the six systems, referring to the character of supervision, are enumerated; under State Forests, the existence of such is stated and manner of acquisition in each State; under State Assistance to Individuals and Corporations, four different methods are in vogue; under Restrictions Directed to the Prevention of Forest Fires, seven ways are employed in different States; on Disposal of Logging Débris, five States have legislated directly, and in four States slash may be adjudged a public nuisance; legislation regarding safe operation of railroads, various systems of fire control, liability for fire damage and penalties, each has the States in which legislation is enacted enumerated. In the other chapters, of course, the historical detail by States is given.

A classified table of contents and a very full index make the book handy for the student of any one phase or State. For the historian it is an invaluable reference book. For this purpose, however, we would have liked to see a fuller list of references to the precise laws.

B. E. F.

Mechanical Properties of Woods Grown in the United States. By J. A. Newlin and Thomas R. C. Wilson. Bulletin 556, U. S. Department of Agriculture, Washington, D. C. 1917. Pp. 47.

This bulletin contains a valuable summary of mechanical tests on 126 species of native woods tested in a green and air-dry condition in the form of small, clear pieces. According to the authors, it is planned to continue the series until all species which are important, or which give promise of becoming important, have been included. Though the results of tests on a number of at present non-commercial species are given, all commercial species, as, for instance, Osage orange (*Toxylon pomiferum*), are not represented. The publication of these data, as the authors state, is largely for the benefit of industries that are anxious to find new species to supply waning supplies of present material, though in the case of the data on hardwoods this object will possibly be more or less defeated, due to the lack of comparable data on foreign woods now used by many industries. The especial value of this publication lies in the fact that unlike similar previous reports of the Forest Service, which the authors indicate have contained insufficient data for practical use, the average moisture content of the various specimens tested is given in each case. As a rule, the test specimens were taken from the top 4 feet of a 16-foot butt log. The number of test specimens from

each tree varied from 40 to 120, depending upon the size of the tree, though in the case of some species, such as elder (*Sambucus glauca*), a much smaller number of tests was undoubtedly made. The number of trees of each species from which test specimens were obtained varied from 2 to 60. The actual number of tests in each case is, however, not stated. The bulletin contains a description of the methods used in making the tests, which practically duplicates a portion of Circular 38, "Instructions to Engineers in Timber Tests." This is justifiable in view of the lack of understanding on the part of many commercial concerns of the methods used by the Forest Service in timber testing.

B. L. G.

The Substitution of Other Materials for Wood. By Rolf Thelen. U. S. Department of Agriculture, Report No. 117. Contributed by the Forest Service. Pp. 78.

This report contributes valuable data on the relative increase in use of wood and other materials in certain fields. The word substitution is in many of the fields a misnomer, since no one can say which of the materials used acquired priority rights, as it were. Hence a better title might have been, "The Relative Increase or Decrease in the Use of Wood as Compared with Other Materials in the Same Field." Graphic methods are used in presentation of much of the data, so that the results of the investigations may be seen at a glance. In regard to prices, it is shown that lumber increased faster than other commodity prices prior to 1907; since then scarcely as fast. Also per capita consumption increased prior to 1907, but since then appears to be falling off. As to the total national use of the various commodities, lumber has been falling off somewhat since 1907. Common red brick has fallen off in the same period. Use of iron and steel shapes has increased slowly, while the use of cement has increased rapidly. It is admitted, however, that this does not at all indicate displacement of wood, and this point needs special emphasis. In the field of minor uses, metal trim and metal furniture, steel and part steel freight cars, ships and vehicles, where in most cases wood has decreased in these fields. As to roofing materials, wooden shingles show a gradual decrease, while substitutes show a constant increase in use. In box making and allied uses, pulp boxes are making inroads on the use of lumber boxes. In paving and pipe, use of wood seems to be on the increase. The total substitution claimed is summarized in Table 24 at 27,715,000,000 for wood in all forms, including fuel, and the substitution for lumber 8,090,000. Much of this,

it must be affirmed, is substitution only in the sense that wood might have been used, though having in many cases no better priority claim to the field than the so-called substitute. Doubtless much of the use of other products is due to their availability in the most populous regions, whereas more and more lumber has to be brought from the South and the Pacific coast, thus adding heavily to the cost. A just conclusion at the end of the report is that increased studies of the properties of wood and public education on the subject will enable it to hold its own where it is the best material for the purpose at hand.

B. P. K.

Die Bedeutung des Waldes insbesondere im Kriege (Importance of Forests in War Time.) By Prof. Dr. Franz von Mammen. "Globus," Dresden, 1916.

Professor von Mammen discusses the extraordinary part which the forest has played in the world war, as source of wood for the army's tremendous needs, as source of hitherto unheeded food products for man and beast, as source of other raw materials, such as tanbark and naval stores, and its tactical importance in battle.

RECENT PUBLICATIONS

Journal Forestier Suisse, 68, 1917—

Perte d'accroissement dans un perchis d'épicéa causée par la grêle. Pp. 87-94.

Dégats par la grêle en forêt. Pp. 145-6.

Schweizerische Zeitschrift fur Forstwesen, 68, 1917—

Der Stand der Hausschwammforschung. Pp. 141-9; 195-207.

An exhaustive discussion of the status of the problem of the rot in buildings.

Direccion General De Agricultura Y Defensa Agricola—

Los Incendios en los Andes Paragonicos. By Max Rothkugel. Bulletin No. 3. Pp. 1-32.

Los Bosques Patagonicos. By Max Rothkugel. Pp. 207. 1916.

The Timberman, XVIII, January, 1917—

Organization of the Chinese Forest Service. By Forsythe Sherfesee. Pp. 45-6.

Canadian Forestry Journal, XII, 1916—

Forestry in Connection with Pulp Mill Operations. Pp. 403-5.

Paper read at the meeting of the Technical Section of the Canadian Pulp and Paper Association.

The opening sentence gives the author's estimate of the relation: "Forestry is the most important thing in connection with pulp-mill operations."

New Ways of Taking Dollars from Forest Waste. Pp. 809-11.

An account of experimental work at the U. S. Forest Products Laboratory, Madison, Wisconsin.

The New Zealand Forestry League—

Objects and Rules of the New Zealand Forestry League.

Reasons for Its Establishment. Its Aims and Objects. Wellington. 1917.

Scientific National Forestry for New Zealand.

Inaugural address delivered at the initial meeting of the League in the Chamber of Commerce, Wellington, on July 11, 1917, by D. E. Hutchins, of the Indian and South African Forest Services.

PERIODICAL LITERATURE

FOREST GEOGRAPHY AND DESCRIPTION

Arctic Forest Conditions

In an article by R. M. Anderson, giving an account of the recent explorations in the Canadian Arctic coast, the following data regarding "timber areas" are given:

"The northern limit of spruce trees on the Coppermine River is about 20 miles from the coast, although some stragglers are found growing 5 to 10 miles from the coast on Naparktoktuok Creek, a few miles east of the river. Willows of good size, and from 10 to 15 feet high, are found in many places north of the tree line, and persist until they dwindle to small ground-creeping shrubs on the northern islands and wind-swept mainland coast.

"To the west there are no trees anywhere near the coast until we come to Franklin Bay, where we find spruce of fair size 10 or 15 miles inland, in the valley of Horton River. Spruce comes rather close to the coast on the Anderson River south of Liverpool Bay. Still farther west we find the great northward extension of timber in the Mackenzie delta, fair-sized trees occurring northward nearly to Richard Island about 150 miles north of the Arctic Circle.

"On the Horton River, the Coppermine River, around Dismal Lake, and to a less extent farther west, we often noted the large proportion (in some places 90 per cent) of dead spruce trees near the northern limit of timber. There seemed little evidence of fire destruction, and the explanation that the northern regions are becoming colder and the vegetation retreating seemed inconclusive. On one of our winter trips Mr. Johansen accompanied a sledge party southward to the timber-line on the Coppermine River and made a careful study of conditions. He found that practically all the dead trees showed traces of the ravages of bark beetles, three species of them being found."

The Geographical Review, October, 1917, pp. 255-256.

Australian Forestry

From the review by Dr. Schlich of Mr. D. E. Hutchins' monumental volume of 434 pages on forestry in general and Australian forests in particular, we extract the following data of interest: Mr. Hutchins is well known as for many years in charge of the Cape

Forest Department and later of British East Africa. The book is the result of a two years' study of Australian conditions.

Eucalyptus and various wattles (acacia) are the most valuable and principal species and are developed as timber in that part of the Coast belt which has a rainfall of 20 inches and more, some 160,000 square miles. Areas of the Coast belt with smaller rainfall, some 700,000 square miles, furnish only wood for domestic purposes. Clearing and fires have invaded the timber forest in the extra-tropical area of the belt. Fires have injured the timber and thinned the stands and natural regeneration is poor; hence the policy of clearing and planting, which is expensive, has been advocated. Partly on account of the poor condition, partly on account of the character of the native timber, Australia must import increasingly coniferous material.

While each Australian colony, except Tasmania, has a forest department, these are much at the mercy of politics; the staff is insufficient and mostly not technically educated. Although the establishment of a forest school in South Africa proved barren of results, Mr. Hutchins advocates introduction of educated superior officers and the establishment of a forest school, and Schlich properly objects to this solution of the problem, substituting several schools for training of subordinates, but of superior officers at Oxford. A national department, supposedly like the Indian, is to supplement the State departments.

The setting aside of permanent State forests, which has only inadequately been done (some 17,000 square miles; other sources claim 26,000 square miles), should be extended to comprise 74,000 square miles in the extra-tropical timber belt. The idea of replacing the natural forest by planting is rejected as very expensive and risky except as far as light woods are needed. In the way of protection of fire, broad fire lanes which can be turned into grazing lands are advocated. Details of conditions in the several States are given.

While Dr. Schlich considers the author's conclusions frequently as "of a risky nature, and in several cases even startling," he finds the arguments on the whole sound and of great service to Australia.

The somewhat diffuse character of the book is perhaps best shown by citing the chapter headings: I—Preliminary observations on the principles of modern forestry; II—Practical forestry; III—Popular forestry; IV—Economics of Australian forestry; V—Factors influencing Australian trade in timber and forest produce; VI—Special to western Australia; VII—Arboriculture, public and private; VIII—Present condition of forestry in each of the Australian States; IX—Recapitulary digest.

Quarterly Journal of Forestry, October, 1917, pp. 271-278.

BOTANY AND ZOOLOGY

Larches of the World

With a monograph on larch, including a discussion of the identification and distribution of the different species of the world, their varieties, silvicultural characteristics, susceptibility to insect and fungus diseases, volume production, characteristics of the wood produced, its utilization, and the management of the different larches in pure and mixed stands, Gunnar Schotte, editor of *Skogsvårdsföreningens Tidskrift,* has made a very important contribution to forestry literature of recent years. Though the whole article contains a mass of valuable data so comprehensive in scope that it is only possible in this review to direct attention to the monograph, the following keys to the identification of the larches may prove of especial interest to professional foresters:

Key to Larches, Based on Cones [1]

I. Cones very large, more than 2 to 2.5 cm. long.
  A. Bracts longer than cone scales.
    a. Bracts straight, pointing forward.
      1. Edges of cone scales smooth.....*L. occidentalis* (1)
      2. Edges of cone scales fringed....*L. lyallii* (2)
    b. Exposed portion of bracks bent backward.
      1. Cones 7 to 10 cm. long..........*L. griffithii* (4)
  B. Bracts shorter than cone scales.
    a. Cone scales straight, pointing toward tip of cone.
      1. Bracts visible, ripe cones not downy or villose.
        (*a*) Young twigs glabrous..*L. europeæ* (7) [2]
        (*b*) Young twigs slightly pubescent ....*L. potanini* (5)
        (*c*) Young twigs hirsute....*L. olgensis* (14)
      2. Bracts not usually visible, ripe cones downy or villose........*L. sibirica* (10)
    b. Tips of cone scales bent backwards....*L. leptolepis* (6)
II. Cones small, less than 2 to 2.5 cm. long.
    a. Cones very small, 1.5 cm., occasionally 2 cm., long..........................*L. americana* (18)
    b. Cones a trifle larger, up to 2.5 cm. long.
      1. Leaves approximately 3.5 cm. long.*L. dahurica* (12)
      2. Leaves approximately 2 cm. long.*L. kurilensis* (15)

Key to Larches, Based on Leaves and Twigs [3]

I. Young twigs not glabrous.
  A. Young twigs covered with brownish gray tomentum ....*L. lyallii* (2)

[1] *Larix chinensis* is not included. From descriptions in available works, its cones are closely similar to those of *L. americana.*

[2] Cones of *L. europeæ* vary considerably in size and form.

[3] *L. potanini, L. olgensis, and L. chinensis* are not included in this key, as a sufficient supply of material was not available to the writer.

B. Young twigs slightly tomentose, or hirsute.
   a. Leaves blue-green,[4] young twigs reddish brown.
      1. Leaves about 2 to 3.5 cm. long...*L. leptolepis* (6)
      2. Leaves about 2 cm. long.........*L. kurilensis* (15)
   b. Leaves green.
      1. Ends of branchlets pendulous, when young reddish brown, slightly hirsute, leaves up to 4 cm. long ....*L. griffithii* (4)
      2. Branchlets not pendulous, rigid, when young yellowish brown, pubescent, leaves up to 3 cm. long ....*L. occidentalis* (1)

II. Young twigs glabrous.
   A. Leaves relatively long, 3 to 5 cm. Dry twigs have strong odor of jasmine................*L. sibirica* (10)
   B. Leaves of medium length, 2.8 to 3.5 cm. Fresh twigs have slight odor of balsam...........*L. dahurica* (12)
   C. Leaves relatively short, seldom over 3 cm.
      a. Young twigs grayish yellow. Dry twigs often with slight jasmine odor.......*L. europeæ* (7)
      b. Young twigs reddish brown (small cones) ....*L. americana* (18)

In considering the availability of the various larches in forest management in Sweden, Schotte reaches the following conclusions:

Larix europeæ is cultivated in nearly all parts of Sweden, as far north as Piteå, and even to a limited extent in Haparanda. In the more remote portions of Norrland it is seldom found. Planting was begun in 1750, though the first forest plantations were not established until 1780. Most of the seed for this early planting was obtained from Scotland. The resulting stands are especially noted for their tall, straight boles and thin crowns. These characteristics are so pronounced that Schotte asserts that a special Scotch variety of *Larix europeæ* must be recognized.

Since the middle of the nineteenth century a large proportion of the larch seed used in Sweden has been obtained from Tyrol. The resulting larch stands contain a high percentage of crooked and illy formed boles, while the height growth is inferior and the crowns are bushier. These characteristics make the Tyrolean larch unsuitable for mixed forests and a poor tree from the standpoint of timber production.

Scotch larch can advantageously be grown on the best forest soils. Merchantable logs are quickly produced in about a third less time than is required for Baltic pine. As larch is very subject to a disease known as "larch cancer" (caused by an ascomycete, *Dasyscypha willkommii* Hart), Schotte states that it should be planted in admixture with other

[4] The green-leaved forms of these species prove exceptions.

trees whenever this is possible. A mixed forest of Scotch larch and Baltic pine or birch is especially recommended. Admixture with spruce should be avoided or only attempted with spruce as an understory. Only seed from Scotch or Silesian larch, which can be conveniently obtained in Sweden from existing stands, should be planted.

Larch should be thinned early and heavily. The first thinning should release the crowns and remove the suppressed trees, followed by heavy "low thinnings," removing the suppressed trees with bushy crowns,

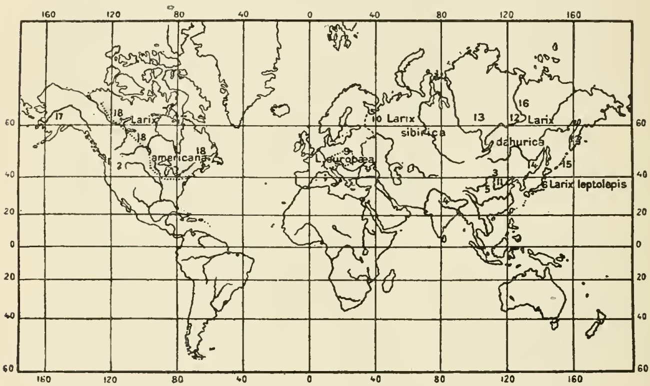


Fig. 1.—*Map of the Approximate Distribution of the Larch Species*

1, *L. occidentalis;* 2, *L. lyalli;* 3, *L. chinensis;* 4, *L. griffithii;* 5, *L. potanini;* 6, *L. leptolepis;* 7, *L. europeæ;* 8, *L. europeæ* × *leptolepis* (odlad i England); 9, *L. polonica;* 10, *L. sibirica;* 11, *L. principis rupprechtii;* 12, *L. dahurica;* 13, *L. dahurica* × *sibirica;* 14, *L. olgensis;* 15, *L. kurilensis;* 16, *L. cajanderi;* 17, *L. alaskensis;* 18, *L. americana;* 19, *L. americana* × *europeæ* (odlad i England).

especially if an understory exists. This enables the stand to resist "cancer" more effectively. To avoid attacks of this fungus, it is even advisable to prune 20 to 30 year old stands.

The timber produced by *Larix europeæ* is valuable for house construction, telephone and telegraph poles, mine props, etc., and in contact with the soil is much more durable than Baltic pine.

Larix siberica is recommended for planting in the north and central parts of Sweden. Like Scotch larch, the boles are tall and straight. It is attacked by "cancer" in much the same degree as Scotch larch, and hence the same management is prescribed for this species. The wood exhibits the same characteristics as Scotch larch.

Larix leptolepis is adapted for planting in southern Sweden. It exhibits very rapid height and volume growth, though the rate of growth begins to decrease at a much earlier period than in the case of the two larches previously mentioned. It is also subject to attacks by "cancer." It is less intolerant of shade than the other larches, but on account of its bushy crown is troublesome in mixed stands. *Larix leptolepis* is therefore only suitable for planting on good soils where a large volume production must be obtained in a short time, though the timber is not as valuable as that of the other larches.

Larix occidentalis is similar to *Larix europeæ* and *Larix siberica.* It is also subject to "cancer" attacks. Careful handling is advisable in planting this tree in Sweden.

B. L. G.

Lärken och dess betydelse för svensk skogshushållning, Skogsvårdsföreningens Tidskrift, April-June, 1917, pp. 447-707.

SOIL, WATER, AND CLIMATE

Toxic Atrophy

Foresters and botanists in the United States are not in accord on the effect of toxic soil constituents as a cause of soil exhaustion. In the article under review, the Rev. E. A. Woodruffe-Peacock states that "soil exhaustion, so far as forestry is concerned, is that a woodland of one species cannot grow forever on the same spot, but will sooner or later fail to renew itself on account of some action vital to itself which it has upon the soil." The author contends that the exact reason why this is so demands careful study, although heretofore it has eluded the most searching analysis. In the discussion of soil exhaustion he calls attention to the following four points:

(1) The failure for the time being of some soil constituent generally found in soils.

(2) The absence of the beneficial help of friendly bacteria and the overabundant presence of inimical ones.

(3) The presence of the *mycelia* of fungi around the roots of seedlings and of young trees on woodland soils.

(4) Toxic materials, the products of decay, left by species on and in the soil.

The author contends that soil exhaustion is not caused by (1), as only small quantities of soil constituents are used in tree growth, and they are always found in abundance where a species is failing from soil

exhaustion. He states that the feeding roots of trees growing in the open have an approximate span of three times the distance of the outermost twigs. Regarding (2), the writer states that soil bacteria do not explain the failure of a tree species after long-continued growth on the same spot, and they are not sufficient to account for all that may be observed in old woodlands of a single species. Although he concedes that (3) is of considerable importance, possibly secondary in causing soil exhaustion for a given species, all must give way to (4), namely, that the active agent that appears to bring about soil exhaustion for forest vegetation is "toxic atrophy," caused by a poison which is left in or on the soil during the process of plant decay. This poison left by decay of every species of plant is more inimical to the young of its own species than to that of any other.

The basis for the author's conclusion is entirely empirical and without experimental data.

J. W. T.

Quarterly Journal of Forestry, Vol. XI, April, 1917, pp. 88-93.

Redwoods, Rainfall, and Fog

The distribution of the redwood (*Sequoia sempervirens*) has been commonly correlated with the summer fogs so characteristic of the coast of California. Cooper has recently made a study of redwood distribution and meteorological data. The investigation covered the greater part of two years in the Santa Cruz Mountains, where the redwood forest is the prevailing vegetation type over considerable areas of the range. The author states that in the above mountains certain areas, apparently not differing in topography and soil from near-by ones which support a luxuriant redwood forest, are practically without this species. He cites the Black Mountain and Monte Bello Ridge as conspicuous examples of the former. A comparison was made of the precipitation on near-by areas, some without redwood and others with a heavy stand. A series of rain gauges was established from the coast eastward to and beyond the crest of the Santa Cruz Range. The records show a great difference in the precipitation at stations only a few kilometers apart, and altitude seems to be the main factor in influencing the amount of precipitation. The amount of rainfall at the various stations bears no apparent relation to the presence of redwood. Some stations without redwood had more precipitation than others where it was the dominant species. The conclusion is drawn that rainfall alone is not the deciding factor in ac-

counting for the presence of redwood, and that abundant precipitation is sufficient in itself to make possible the development of the redwood forest on mountain slopes.

Many illustrations from field observations are presented to show that the redwood is unusually sensitive to the danger of water loss, even when the soil water supply is ample. On areas having abundant winter precipitation, but little summer fog, redwood is excluded except in the immediate vicinity of streams. This is probably due to the summer desiccation of the soil and the high evaporation rate.

The apparent effect of the summer fog is to reduce the evaporation rate and thus tide the redwood over the critical dry period of summer, when there is little available moisture in the soil. The four stations located in the fog-frequented area aroung Kings Mountain, although covered with a heavy stand of redwood, gave a slightly lower precipitation than the four stations in the fogless area of Black Mountain, entirely devoid of redwood.

The author's conclusion is: "For the full development of the redwood forest, covering mountain slopes which may become relatively dry as well as the immediate environs of permanent streams, heavy winter precipitation is necessary, but alone is not sufficient. Abundant summer fog is also essential, its effects being to decrease the water loss and in some degree add to the soil water supply. Where summer fogs do not occur, or where they occur infrequently, no true forest of redwood is possible, even though the rainfall be as high or higher than in the fog-frequented areas. In areas of the former kind the infrequent redwoods were confined to the banks of streams, as in regions of deficient precipitation."

J. W. T.

The Plant World, Vol. XX, June, 1917, pp. 179-189.

SILVICULTURE, PROTECTION, AND EXTENSION

The Resistance of Seed-coats to the Intake of Water

In experiments by Davis on the resistance of seed-coats of velvet leaf (*Abutilon theophrasti*) to the intake of water, the results indicate a remarkably wide range in the resisting power of the coats of these seeds to the absorption of water. The seeds were placed in vials of water and subjected to various temperatures. Although some seeds were swollen within three weeks after placing them in water, others of the same lot

remained for six years unaffected, and when placed under suitable conditions germinated as quickly and apparently with as much energy as fresh seed. The inference is that the more resistant seed of this species may lie in the ground many years before germination takes place.

These experiments by Davis are interesting, in that they are in accord in a general way with the results obtained by foresters in the study of the germination of tree seeds. Evidence is rapidly accumulating to the effect that some of the seeds of many species of forest trees lie on or in the ground for long periods before germination can take place. It is possible that in some cases at least this is due to the resistance which the seed-coats offer to the intake of water.

J. W. T.

The Botanical Gazette, Vol. LXIV, August, 1917, pp. 166-167.

Natural Reproduction from Seed Stored in the Forest Floor

The questions centering around the distribution and frequency of seed trees has been subject to much discussion in recent years in the United States. A few years ago J. V. Hofmann began a study in District 6, United States Forest Service, to determine the efficiency of seed trees in restocking and the distances from them that seed is disseminated. The results of this study and the investigation of reproduction, following extensive burns in the Puget Sound region, led to the investigation of the viability of seed stored in the duff and the surface soil of the forest, and the possibility of its being the source of a widely and evenly distributed reproduction following extensive lumbering operations and fires rather than the scattered seed trees left in lumbering or on the margins of burns.

From comprehensive studies on the average number of seedlings per acre at various distances from seed trees, both on burned and unburned slash, it appeared that coniferous seed trees are effective for a distance of only two or three chains, and that reproduction occurring in unburned slash is distributed without relation to the distance from seed trees.

The above conclusions led to the investigation of the litter and surface soil in order to ascertain if they contained germinable coniferous seed in quantity to account for reproduction. Hofmann reports large numbers of seed in the duff, which germinate as soon as the stand is felled or moderately burned, thus admitting light and heat to the forest floor. The series of studies upon which his conclusions are based extended

over a period of five years, from 1912 to 1916, inclusive. Eighty acres were intensively examined by the transect and plot methods, and surveys were made of 750,000 acres of burned and 7,780 acres of cut-over land.

On the Columbia burn of 1902 the duff was only partially destroyed by fire. Excellent coniferous reproduction almost immediately covered the area and was of the same species as made up the burned forest. A careful analysis of the reproduction, its age and distribution, led the author to the conclusion that the duff is the principal factor in reproduction in the Northwest after denudation. Where the duff is not completely destroyed by fire the seeds therein which escape injury are responsible for the reproduction, and not the seed trees on and adjacent to the area.

The investigation established the fact that the reproduction on the burn occurred in variously sized patches irregular in outline, forming a mosaic with patches of grass and other herbaceous vegetation conforming to the irregular burning of the duff, the reproduction occurring on the unburned duff.

A burn of 1910 on the upper Cispus River completely destroyed the duff. The reproduction on this burn is reported by the author as only in the immediate vicinity of seed trees. His conclusion is, when the duff is completely burned the reproduction which follows is in inverse numerical proportion to the distance from the seed trees.

Studies made on areas burned at intervals since 1864 led the author to conclude that the seed of the whitebark pine may, under favorable conditions, remain in the duff for 21 years without germinating—possibly through two or more fires—and still retain its viability. Although some dormant seed may survive repeated fires, it was found that while the reproduction is abundant and well distributed after a single fire if the duff is not completely burned, it is extremely scanty and irregularly distributed after a second fire.

Many analyses of the duff from various types of forest in the Northwest and from recently denuded areas revealed from half to two coniferous seeds per square foot of soil. Unfortunately the author gives no tables of germination of the seeds of the various species separated from the duff. The western white pine seed recovered from the duff in northern Idaho were, however, germinated by Brewster. He secured a germination of from 2 to 20 per cent.

The author discusses the dormancy habits of the seed of different species and restates the well-known fact that in nursery and field practice the best germination is often attained two or three years after seeding. He concludes from the comparison of the year of the fire

and the date of germination that delayed germination in the conifers of the Northwest is as follows:

	Years
Douglas fir	6
Noble fir	3
Silver fir	5
Western hemlock	6
Western white pine	6
Pacific yew	10
Dwarf juniper	10

The delayed germination, in the author's belief, explains the age classes in the reproduction found in open burns where there are no seed trees.

Extensive tests on the artificial storage of seeds in the duff under the forest canopy have been undertaken with many western species. Unfortunately these studies have not been carried sufficiently far to determine the period of delayed germination for the several species. The author states, however, that at the beginning of the second season germination tests show some seeds of all the species stored still viable.

The main conclusions drawn from the author's studies are:

(1) The distance to which seed trees are capable of restocking the ground is limited to from 150 to 300 feet. They cannot, therefore, account for the restocking of the large burned areas.

(2) The irregular, dense stands of young growth are due to seed stored in the forest floor or in cones. This seed retains its viability through the fire and is responsibile for the dense reproduction that springs up after the first fire.

(3) The even-aged stands of reproduction immediately following a fire, regardless of location of remaining seed trees, the irregular alternation of dense stands of reproduction with grass areas, and the failure of reproduction on areas burned over by a second fire before the stand reaches seedings age or by consuming all of the duff and precluding any possibility of seed remaining after the fire, all point to the seed stored in the duff as the principal source of seed responsible for the restocking.

(4) The ability of the seed to retain its viability when stored in the duff or when retained in cones during fires has been further demonstrated by recovering and germinating seed from duff under forest conditions and by recovering and germinating seed from cones which passed through a crown fire.

Hofmann's studies are of great interest and of much practical value. They do not, however, completely solve the problem of how long the seeds of the northwestern conifers remain viable in the ground in

sufficient number to be a large factor in reproduction. He gives no tables of germination of the seeds of the various species recovered from the duff, relying upon Brewster's germination of the seed of western white pine recovered from duff in northern Idaho, where even with this most resistant species the germination was only from 2 to 20 per cent. Careful germination tests on the seed recovered from duff would have added a great deal to the value of the paper.

The reviewer had the opportunity in July last to see the seed artificially stored in duff at the Priest River Experiment Station and was impressed by the small number of viable seeds of most species at the end of the second year.

The forests of maritime pine along the Bay of Biscay and on the sand dunes of the Landes of Bordeaux in France are often felled over extensive areas, depending upon the seed in the soil for regeneration. Although the seed of the previous year's crop is generally relied upon, the delayed germination of previous years is also important.

Extensive fires along the San Maurice River in Quebec and elsewhere in Canada are followed by abundant reproduction, due probably to seed storage in the duff. (Only on the bluff shores of the river!—Ed.) The reproduction following fires that kill all vegetation in southern forests is scanty and uncertain. This is probably due to the absence of duff.

Although Hofmann's researches add a flood of light to our present knowledge of reproduction, they do not absolutely determine how long the seeds of various coniferous species remain viable in duff in a percentage to be of importance in reproduction. This can only be determined by recovering seeds in duff and by later germination tests ascertaining their reduction in viability for each year the seed is stored.

J. W. T.

Natural Reproduction from Seed Stored in the Forest Floor. Journal of Agricultural Research, Vol. II, October, 1917.

Storage of Oak and Hickory Seeds

In the autumn of 1913 Delavan collected the fruits of eight species of oak and hickory in the vicinity of Ann Arbor, Michigan. The fruits of all species were thoroughly ripe and sound and were divided into four equal parts. One part was placed in closed but not sealed fruit jars and deposited in a pit approximately one foot under the surface of the ground. The relative humidity of the pit was high and the minimum temperature from late autumn

to April 1 was — 5° C. A second part was also placed in unsealed jars and deposited in an ice-box, where the temperature varied from 1° to 8° C. The relative humidity averaged about 95 per cent. A third part was dried at a temperature less than 40° C. until the fruits had lost about 5 per cent of their original moisture, when they were placed in closed but unsealed jars and deposited in a room where the temperature averaged about 22° C. and the relative humidity about 47.5 per cent. The fourth part was stored in closed jars and subjected to the same condition as part three.

Ten fruits of each species from each of the four parts were planted in the greenhouse each month from October to April, under conditions favorable for germination. The average percentage of germination was as follows:

	Pit *Per cent*	Ice-box *Per cent*	Dried *Per cent*	Untreated *Per cent*
Hickories	83	88	41	37
White oaks	77	87	62	45
Black oaks	81	99	18	29

The average germination per cent of the seeds stored in the pit and ice-box were fairly constant for each month from October to April and gave the highest percentage of germination, although those stored in the ice-box gave a slightly higher per cent than those in the pit.

The germination per cent of those stored dry and untreated, not only gave a much lower average germination per cent, but the viability steadily decreased from October to April and in many species dropped to zero in two to three months after storage.

J. W. T.

The Relation of the Storage of the Seeds of Some of the Oaks and Hickories to Their Germination. Mich. Acad. Sci., Vol. XVII, 1916, pp. 161-163.

Protection from Railway Fires in Sweden

A committee composed of foresters and railway officials recently submitted to the Swedish Riksdag a report[1] on means of controlling forest fires originating from railroad locomotives. The following is of interest to American foresters: During the period from 1876 to 1914, 130,438 hectares[2] of public forest were burned over. Private lands bring the established total up to 500,000 hectares. In 1914, which is considered one of the worst years, 6,447 hectares, representing a money value of 1,500,000 kroner, were burned. In this year 740 fires started along the

[1] Briefed in *Skogvårds forenings Tidskrift,* Häft 1, 1917.
[2] 1 hectare = 2.47 acres; 1 krone = about 25 cents.

Stockholm-Hallesberg line alone. The width of the danger zone along a railroad varies with ground cover, topography, and exposure to wind. Most of the fires start within 25 meters of the track, but occasionally the distance is as great as 50 meters. The majority of the fires starting within 7 to 8 meters of the track originate from material dropped from the ash-pan, while practically all of those starting at a greater distance are the result of sparks from the smokestack. Elaborate fire lines, such as are employed in parts of Germany, are considered impractical in Sweden for economic reasons. One difficulty is in the rocky soil, which can be cultivated or ditched only at great expense. To install the German system of fire lines would involve an estimated initial outlay of 1,452,000 kroner and an annual maintenance cost of 200,000 kroner. Since the mean annual damage, as represented by indemnities paid out by railroads, is only 137,000 kroner, the above expenditure would not be warranted. An added argument against expensive fire lines is the probability that in the near future many of the railroads will be electrically operated. Intensive preventive measures are, however, warranted along limited stretches of railroad traversing forests of unusually high value. The relative merits of various protective measures are discussed. Clean fire lines are usually too expensive. While of recognized value, they present the disadvantage of allowing the entrance of wind, which may carry sparks over the cleared space into inflammable material beyond. Close belts of coniferous trees shade out practically all ground cover, but must be kept free of litter. Such belts offer a great advantage over open strips, in that they act as a screen against flying sparks. Of the prevailing types of fences bordering the right of way, stone fences or walls are considered most desirable, since they act as a barrier against the spread of fire. Wire fences are at least not objectionable, since they are not in themselves a fire menace. Wooden fences, on the other hand, are unqualifiedly condemned. Hedges are objectionable because inflammable material collects underneath them. Preventive measures must extend beyond the right of way. This brings in the question of the responsibility of landowners. It is proposed to enact laws which require all owners to yield their lands to such protective measures as the authorities adopt. The plan is, in brief, to maintain a dense belt of coniferous trees extending from 30 to 40 meters on either side of the track. Limbs growing near the ground will be removed and, if conditions warrant, all litter and ground cover will be removed. It is anticipated that these strips can be made to yield a revenue not far below that of forests under the usual system of management. The rotation will be short, evidently for

the purpose of maintaining stands dense enough to exclude undergrowth. These forest belts will be managed by a trained forester, whose salary will be paid by the railroad company. All operations not entering into the usual silvicultural practice will likewise be paid by the company.

G. A. P.

MENSURATION, FINANCE, AND MANAGEMENT

Swiss Forest Policy

The October number of the *Journal Forestier Suisse* is almost entirely taken up by the proceedings of the meeting of the Swiss Foresters Association, which after omitting meetings for some time convened again in August. The main business was the presentation of three reports by a committee, instituted in 1911, to formulate action for the improvement of the social and financial position of Swiss foresters and the improvement of forestry practice.

The war has in several directions been favorable to this movement, in that the importance and economic value of the forests have come to be more fully realized. The total forest area of the country, around 2,000,000 acres, entailing in 1916 a total expenditure of around $340,000, secured a net income of two million dollars, or only $1 per acre—a very low output, in spite of the increased cut over that of the ante-war times and the increased export of nearly 15 per cent. The overcut has, however, only to the extent of 1 per cent taken place in the public forests, and this has led to bringing the private forests under surveillance of the government.

The total value of Swiss forests, figured on their yield, is stated as between 250 and 260 million dollars, equaling the value of all the Swiss railroads, and as only 200 foresters are engaged in the management of this valuable property they claim more adequate recognition. It appears that the foresters in the public forests are not always allowed to direct their work without interference of non-professional administrators, and most private owners consider themselves competent to manage their properties without technical advice. A more direct technical and intensive management, it is contested, could increase the production by 15 cubic feet per acre and year.

To clinch the argument, Biolley, one of the reporting committee, adduces figures from a given communal forest of less than 300 acres,

which had been overcut, overgrazed, and maltreated in every way. It was 50 years ago when a change in management took place, and in the last 25 years it is shown how the stock has been increased, the age-class distribution improved, the average tree volume and the increment increased; all this while the cut had been increased from 64 cubic feet per acre in 1892 to 101 cubic feet in 1916.

The most important motion, however, was based on the fact that the federal government in February, 1917, found it necessary, in order to prevent mismanagement during the war, to place all private forests under the protection forest laws of 1876 and 1902, and the Society proposes to press a memorial to the federal government to continue this supervision of private property after the war and to revise the law of 1902, so as to extend the definition of protection forest in the economic direction.

A broad educational campaign among the people is to be carried on.

Journal Forestier Suisse, September-October, 1917, pp. 153-174; 181-192.

Thickness of Bark

Wretlind[1] has made an exhaustive investigation of the thickness of bark in Norway spruce (*Picea excelsa*) and Scotch pine (*Pinus sylvestris*) in Sweden. Among the conclusions are the following: (1) The thickness of the bark in pine at breast height maintains a constant relationship to the diameter of the stem, regardless of age. In spruce, however, the proportion of bark falls off in the higher diameters. (2) Spruce bark in particular shrinks materially on drying. Investigations showed that the bark of a 40-year-old spruce 22.7 cm. d. b. h., dried at room temperature, shrank in 48 hours from 4.4 mm. to 2.7 mm. in thickness. The breast-high diameter of the tree outside bark decreased during the same period from 22.70 cm. to 22.55 cm. This fact, aside from its commercial significance, demands special consideration in investigations. (3) In spruce the bark is, as a rule, thicker at the base than at breast height; it decreases slightly up to 20 to 30 per cent of the tree height and then rises as the top is approached. The variations are not great, however, and they are compensating to such an extent that for practical purposes the bark per cent at breast height may be applied to the entire stem. The author recommends that timber sold on the stump be measured inside

[1] Wretlind, J. E., *Skogvårds Föreningens Tidskrift*, Häft, 1, January, 1917. 38 pages, 6 tables and 14 figures.

rather than outside bark, and that an actual determination of bark thickness be made for each site involved.

G. A. P.

British Timber and War

Since so many Canadian and American foresters are engaged in securing lumber supplies for the allied armies, it will be of interest to note under what regulations, issued by the Army Council, these supplies are secured in Great Britain.

The Standing Timber Act prohibits the sale of timber without a government permit, so as to prevent speculative sales for driving up prices. This is not intended to prevent sales of real estate with timber, nor to prevent those who are prepared to institute lumbering operations, and no permit is required for purchases by a single buyer not exceeding \$1,500 for three months.

The Home-grown Timber Prices Order fixes maximum prices for ordinary qualities; other assortments to be proportionate in accordance with usual trade customs. All persons engaged in purchase or sale of converted timber grown in Great Britain are required to furnish particulars of their business.

The prices run from 75 cents to \$1 per cubic foot for spruce and Scotch pine and from 87 cents to \$1.12 for larch f. o. b., the lowest for scantling, the highest for half-inch boards. In the case of town yards and mills, an increase of these prices by 25 per cent for sales of 50 cubic feet and over, and by 50 per cent for sales of less than 50 cubic feet, free delivery.

Quarterly Journal of Forestry, October, 1917, pp. 288-291.

UTILIZATION, MARKET, AND TECHNOLOGY

Paper Making in Spain

One hardly thinks of Spain as a paper manufacturer, yet, although 3,000 to 4,000 tons of mechanical pulp and 10,000 tons of chemical pulp are imported, of the 28,000 tons of paper used she manufactures around 15,000 tons. There would be, it is asserted, sufficient wood in Spain to make the import unnecessary if it were accessible, transportation especially from the silver fir and Scotch pine forests of the Pyrenees

and other mountain districts being undeveloped, so that the freight from Sweden to Spain is cheaper than from Sierra Guadarama to Biscay, where important paper-makers are located. It would be necessary for the forest administration to take up the development of these resources seriously.

From *Resumen de Agricultura.* Pulp and Paper Magazine of Canada, August 16, 1917, p. 789.

Conifer Leaf Oil

A. W. Schorger brings in a recent issue of the *Scientific American Supplement* an account of an interesting industry not fully developed, namely, the distillation for their oils of the leaves of spruce, hemlock, juniper, and arborvitæ. Some 40 to 50 thousand pounds, worth 45 to 60 cents per pound, or around $50,000, is the annual production in the United States, and some additional quantities are imported. The juniper and thuya oils are largely used in insecticides, some 15 to 20 thousand pounds; spruce and hemlock oils as perfume in greases and shoe-blacking; various perfumes are based on needle oils, and others are used medicinally as inhalation for lung diseases, in liniments and ointments in rheumatic afflictions.

The greater portion of the oils is distilled by small farmers in New England during winter, but a company in Seattle was engaged in producing red-cedar oil on an extensive scale from cedar brush bundled to contain 100 pounds at $4.50 to $5.50 per ton. A steam pressure of 40 to 90 pounds for 3 to 4 hours was used, and the average yield of oil was 1 per cent of the weight of green material at 40 cents per pound—not enough to cover cost of production. The product was used in an insecticide preparation.

Young trees in the winter months yield the largest product. The attempts at Grant Pass, Oregon, some years ago to utilize western yellow-pine needles for oil and fiber seem not to have been commercially successful.

Forest Service experiments have been conducted on some 20 species and a table of results is given, but none so far are commercially used except those customary ones.

The still and operation and the factors influencing yields of oil are described.

Various oils are now being secured in Germany from hitherto waste materials, such as apple and pear pips, cherry-stones, horse-chestnuts, elm-tree fruit, limes, and asparagus seed.

The Conifer Leaf Oil Industry. Indian Forester, August, 1917, pp. 379-386.

STATISTICS AND HISTORY

Russia's Timber Trade

According to A. J. Sack, Director of the Russian Information Bureau, New York City, during the year 1915, owing to the war, the debit balance of Russia's foreign trade amounted to 385 million dollars. During 1916 it rose to over one billion dollars. It will be imperative after the war that the balance of trade be turned in favor of Russia. That the export of timber, which now holds second place, is capable of great increase as compared with other countries is shown in the following table:

	Timberland (acres)	Export of timber
Russia	1,125,000,000	$89,250,000
United States	603,000,000	134,437,000
Scandinavia	81,000,000	129,489,000
Austria-Hungary	63,000,000	79,203,000

The new Russian Government and the Russian people understand that after the war the need of timber in the European market will open wonderful prospects for the Russian timber industry. By proper development of this industry, Russia will be able to deliver the bulk of the timber necessary for the European countries. It is very possible that in this line Russia will not meet serious competition, either from Scandinavia or from the New World. As to Austria-Hungary, she will have her own needs, and aside from this a big part of her rich Galicia was destroyed during the war.

The development of Russia's timber industry and the export of Russian timber to the European market means for Russia the practical solution of most of her financial difficulties that are bound to arise after the war. The development of the timber industry will create a favorable foreign trade balance and will assist in the payment of the national debt. American capital is familiar with the problems connected with the development of the timber industry, and American capital should therefore play a great part in the proper development of the timber industry in Russia. There is an opportunity in this connection for American timber interests, and every effort should be made to assist Russia in the development of her timber industry in order that American capital can share in the rewards.

The Timberman, October, 1917, p. 486.

NOTES AND COMMENTS

Canadian Lumbermen in France

A Swiss forester gives in the *Journal Forestier* an interesting account of a Canadian lumber camp in France in one of the famous fir forests of the State in the Jura Mountains, la Joux. This is a forest of about 6,500 acres of silver fir of magnificent dimensions—very different from most French forests in which Canadians have been working—the trees being often over 160 feet in height and sometimes 3 feet in diameter. The forest being carefully managed under selection system, or perhaps, we should say, under a long term shelterwood system, is supposed to permit a sustained yield of 222 cubic feet per acre, valued at $50 per acre per year—an unusual figure.

From the description, we judge that the operation is organized like a first-class American logging and mill camp, with both cable and animal skidding and a four-foot circular, with cut-off and trimmer saws, and locomobile to carry the lumber. A stone crusher to furnish material for making the heavy bottomless roads passable alone is an innovation.

It is interesting to note what strikes the European particularly: first, the double bitted axes, but next the unconservative exploitation, the high stumps and disregard of the younger material and regeneration. There is an oversight by the French administration, but the officers cannot get any satisfaction from these "néophyte" woodchoppers, who, it is charged, are not woodchoppers by vocation, being a mixture of negroes, Irish, Polish, Czech, and Anglo-Saxons. But the transport and the mill work are admired for their rapidity and effective organization. The writer also remarks on the complete absence of brutality to the horses—no whipping, no kicking of the excellent animals, which seem of a special race.

"The work at the mill is executed with an exactitude and a rapidity which is remarkable; and the men at this job show an activity which contrasts well with the inferior woodchoppers. The machine does not loiter and works in true American manner." Everything to the last nail comes from Canada. Practical sense and comfort, abundant food, absence of alcohol, baths, infirmary, including an operating room, and a moving-picture show provoke admiration.

An Unusual Log Jam in Norway

A letter addressed to the members of an association of forest owners in Norway by the director of the association, who has charge of the floating of logs in the river Glommen, sets forth the reasons for shortage of raw material for the woods industries depending upon their supply from this district. The situation is unprecedented in the long history of logging in the Glommen River district and has been given much publicity in the press.

The unusually large number of logs cut this year, a late spring and a rapid thaw caused a quantity of timber estimated at 5,400,000 logs to be inextricably piled to an enormous height at Bingfoss lock. The logs have to be picked out one by one and it is not expected that this work can be accomplished in less than two years, even though 130 men work day and night, where the association has been accustomed to employ but 20 or 30 men. And in spite of every effort to control it, more timber still floats down the river to increase the pile. This deadlock not only withholds from operators the timber ordered this spring, but precludes cutting in the woods this winter.

Canada's Forests and the War

The vital importance of Canada's forest resources in the prosecution of the war is becoming constantly more apparent. One example of this is the recent development in the airplane situation. Many experts hold that the best prospect for definitely and overwhelmingly maintaining the supremacy of the Allies is in connection with the war in the air. This involves the manufacture of many thousands of airplanes, toward which the most intense efforts of the Allies are being directed. The most suitable species of wood for this purpose is Sitka or silver spruce, of which great quantities are to be found on the Pacific coast of North America. Canada's share of this timber is large, although by no means over large, and is considered so important in the prosecution of the war that its export, except under license, has recently been prohibited by the government to all destinations abroad other than the United Kingdom, British possessions, and protectorates.

The Imperial Munitions Board has definitely taken in hand the organization of airplane manufacture and steps are being taken to increase the production of airplane spruce beyond all limits previously thought possible. The survey of forest resources of British Columbia,

upon which the Commission of Conservation has been engaged during the past four years, has proved of great immediate value in this connection, since the Commission was able to furnish the Imperial Munitions Board with specific information as to the location and ownership of all the large bodies of spruce in that province suitable for airplane manufacture. The fact that this information had previously been collected enabled the Munitions Board to take up without delay the matter of securing the necessary supplies of this vitally important material.

Mr. H. R. MacMillen, former Chief of the British Columbia Forest Service, is acting as the Pacific coast representative of the official corporation of Canadian Aeroplanes, Limited, under the Imperial Munitions Board.

Kiln Drying of Airplane Stock

Most of the air-seasoned wood available in the United States having been bought for airplanes for the Allies abroad, the procuring of wood for this purpose is a problem, now that the United States has entered the war, airplane manufacturers hesitating to use stock kiln-dried under the methods ordinarily used, having frequently found it unsatisfactory.

Before this situation developed, however, the Forest Products Laboratory at Madison, Wis., had been making a scientific study of the drying of wood and had developed a method which has been very successful, using for preliminary tests partially air-seasoned ash and spruce plank, these being the woods most generally employed in airplane construction.

This material was kiln-dried without injury. Thoroughly green Sitka spruce, white ash (northern and southern), white oak, Douglas fir, western white pine, and mahogany were secured in the log for testing. The spruce and ash logs were cut up and the green material from each species divided into three matched groups. One group of each species was tested green, another has been set aside to be tested when it has air-dried, and the third group was kiln-dried by several methods and then tested. Only the results of the tests on the spruce have so far been analyzed. Comparison with standard tests shows that Sitka spruce can be kiln-dried from the green condition with no more, perhaps less, injury to its mechanical properties than by air-seasoning. Definite specifications have been prepared for kiln-drying spruce green from the saw for airplane construction, and it is stated

that, if rigidly enforced, they will insure kiln-dried stock of this species equal to air-dried stock.

The testing of ash and other species, which include several woods used for propellers, is being pushed as rapidly as possible, results as favorable as those for spruce being expected.

Douglas Fir for Airplanes

Because spruce has been considered most suitable for airplane construction, it is of interest to note that the Italian Government has placed with the West Coast Lumbermen's Association a contract for 25 million feet of Douglas fir for this purpose.

In addition to specifications with regard to width, length, etc., the contract contains the following:

Quality.—Rough green fir, at mill's option to ship dry or partly dry at same f. o. b. mill prices, underweights and overweights for buyer's account.

Grain.—All to show edge grain on the wide face side, *i. e.*, either vertical or within an angle of 45° from vertical. Not less than six annual rings to one inch; no cross grain or burly grain or curly grain to be admitted.

Sap.—To be bright, and to be allowed in any one piece up to one-fourth the width and one-third the length.

Pitch Pockets.—Will allow in any one piece one pitch pocket up to two inches long for each 16 lineal feet.

Knots.—Ninety per cent to be free from knots on all four sides; 10 per cent to allow in any one piece one knot up to ½ inch in diameter.

It is mutually understood and agreed that the above description of this special grade describes the low line of limitation as is usual in lumber grades, and the shipments on this order will contain all the product of this grade and better that is produced when cutting the same. In other words, no portion of the higher grade material shall be selected out and retained by the mill.

Manufacturing.—Must be uniformly sawn. All to be free from chain marks, dog marks, and no hooks to be used in the handling or loading of this stock.

Tally and Inspection.—Tally and inspection at loading mill to be by Pacific Lumber Inspection Bureau, in accordance with special clear quality herein specified, certificate to be furnished and to be final. Buyer's option also to inspect at leading mill in accordance with same special clear specifications herein mentioned, and any difference between the two inspectors to be settled by the chief supervisor of the Pacific Lumber Inspection Bureau or his assistant.

The Spruce Situation

Two phases to the aircraft spruce situation demand attention. The immediate phase is that private industry is unable to meet the demand for spruce. The reasons for this are several. The annual cut of spruce in Washington and Oregon seems never to have exceeded 300,000,000 feet board measure of all grades. The present demand is said to be 150,000,000 feet board measure of airplane stock, but since the average timber will not yield to exceed 15 per cent of this grade, 1,000,000,000

feet board measure must be cut. Thus an enormous expansion of the industry is required in the face of labor shortage and other difficulties. This expansion might be accomplished if the spruce occurred in vast stands adjacent to present logging operations, as do other species of the Pacific coast. But spruce is found for the most part only scattered through stands of other species or in very limited pure stands. It has therefore been taken out as logging of all species progressed.

The sawmill capacity is undoubtedly ample, but to increase the production means an enormous expansion of logging railroads in advance of taking out species associated with spruce. Private industry is probably unable to finance this quickly enough. Furthermore, the recent strike, which the lumbermen claim to have won, is being followed by an aftermath of sabotage and general hampering of operations far more expensive to the industry than a grant of the eight-hour day. Since private industry admittedly cannot handle the situation, necessary steps are already under way to form a military organization to do the work. This is to be under the direction of the Signal Corps. The results obtained will be watched with interest, since success is absolutely essential.

The second phase of this subject concerns itself with the future supply of spruce. According to official estimates summarized in the *West Coast Lumberman* of January 15, 1916, there is about 25,000,000 feet of standing spruce about equally divided between Oregon and Washington. As this is widely scattered in its distribution, it seems obvious that the Federal Government should take over the best stands and conserve them for this purpose so long as no equally good substitute for spruce can be found. Failure to do this will lead to the gradual frittering away of this timber on non-essential uses, such as box boards (much clear timber in the past has been used for this purpose) and other uses where efficient substitutes can be found. The time to take over this timber is now, while the need is glaringly before the public.

Forest Supervisors and Technical Training in Forestry

It was a good piece of work for the *Yale Forest School News* to secure from some eight or ten forest supervisors and print in full their views as to the value for their work of the technical education they had received at their forest school. To ask the question seems to imply the possibility of a negative reply. But we are glad to note that only one of the correspondents goes so far as to say that he fails "to see that today there is any direct advantage to a forest supervisor in having had

a technical training in forestry." He bases, however, his conclusion that "professional training in forestry is a waste of time and expense" and may "actually be a drawback" upon the character of the work which the present-day forest supervisor is called upon to perform, namely, routine work of a purely administrative character without the requirement of much technical knowledge. He holds that "an average supervisor with technical training is as much overeducated for his job as would be an engineer on a switch engine holding the degree of M. E." . . . "A college education supplemented by the best technical forestry education the country can offer tends to make the man who must hold this job of supervisor somewhat dissatisfied with himself." He does admit, however, that "a good education sharpens the intelligence and should aid one's adaptability in any line of work."

We do not know the personality of the writer, to judge whether these are merely expressions of a pessimistic attitude or whether his dissatisfaction is of that quality which lies at the basis of all progress, and augurs well for the expectation that he will through that very dissatisfaction become a better supervisor and a better man. He is at least lacking in realization that we are in a pioneering stage, as far as technical forestry is concerned; that eventually much more of his technical training will be called into play, and that the progress in this direction, in part at least, and in his narrower field of activity will depend upon his own attitude toward professional, not merely vocational, application.

Most of the other contributors to this symposium, while admitting that as far as direct utilization only a little of their school training has been applicable (their work lying in lines of a business manager rather than of a technical forester), admit that this training is of value as a "background in fixing of ideals to work toward and appreciating the ideals of the Service," increasing "breadth of vision," giving "a broader outlook," "fullness of life professionally and personally."

And all recognize that there is a future, when technical work in increasing degree will be demanded of the supervisor. As an earnest that this future is coming, and in some places is at hand, we can quote: "I have found my school training called upon in many cases of actual forest work." "I got at least two dollars' worth of good out of it for every dollar invested." "It was absolutely necessary for me in order to fulfill my duties." "The time has been reached when more attention can be given to the truly technical side of forestry." "The hole to be filled is rapidly assuming a many-sided figure, and he whose knowledge of technical forestry was tentatively lopped off some years back can with little effort fulfill the requirements of the future."

When the writer organized the first forest school on this continent, some twenty years ago, the first question to be settled was naturally what its curriculum should be. It would have been possible to turn it into a vocational course, teaching the little which at the time would have sufficed for such practical work, as was then calling for men—the artisan's attitude. It was, however, deliberately decided to shape the four-year course as if forestry proper, with all that this implies, had been practiced in the country forever and would be practiced by the men passing through the course eventually—a professional course, the artist's attitude. The writer used to begin some of his courses with the, to some of the students, disturbing remark: "The contents of this course you will probably not be called to apply for the next decade or more, but you are bound to know them in order to secure a proper professional attitude, and when it comes to their application you will be handicapped if you have not systematically studied the subject-matter."

There is another thought, which is sometimes lost sight of, namely, that a complicated profession like forestry must tend more and more to specialization, and such specialization calls for different characteristics in men and calls for different kinds of education. Yet only he is efficient in his special corner who has a thorough realization of the bearing of his specialty to the general scheme of things, and for that he needs the systematic study of all phases of the subject.

It is to some extent true, what one of the contributors to the symposium tentatively suggests, that managers are born, not made, and he who is not so born may not acquire the ability to become a manager by a university course—not all men need to become supervisors!—but the born manager cannot but be benefited by systematic study of the whole machine in which he is a cog.

B. E. F.

The Blister Rust Situation

On November 13 a meeting of the Committee on the Suppression of the Pine Blister in North America was held at Pittsburgh, Pa. The conference was attended by some thirty representatives from the Department of Agriculture, various States, and the various Canadian provinces. In the absence of the chairman, Prof. W. Wheeler, the meeting was presided over by Clyde Leavitt. Among the more important points brought out at the conference may be mentioned the following:

1. Comparatively little definite information is available regarding the action of the blister rust in Europe, but such evidence as is available seems to indicate that

the disease is worse in northern than in southern Europe. This may possibly indicate that the disease is apt to prove particularly destructive in the northern United States and Canada, where the white pine attains its best development.

2. The rust is strictly a parasite, and from such evidence as is available it appears probable that the disease is more virulent on healthy, vigorous-growing trees than on weaker ones. This would seem to disprove the theory advanced by some, that the ravages already caused by the disease are due primarily to the poor silvicultural condition of white pine in the Northeast, and that if the silvicultural condition of the stands were improved and nursery stock grown only from good seed from vigorous trees the danger would be practically negligible.

3. Positive proof that the blister rust over-winters on Ribes bushes has not yet been obtained, but circumstantial evidence points to this being the case. The experiments will be continued in the hope of securing indisputable evidence on this point. Evidence has also been obtained that the spores are apt to overwinter on the pine brush resulting from felled trees if the needles stay green all winter. This apparently furnishes an additional argument for brush disposal in the case of pine stands affected by the disease.

4. Wind is probably the main agent in bringing about the distribution of the disease, although it has been proved that it is also distributed to a certain extent by birds and insects.

5. Exact evidence has not yet been obtained as to the width of the strip surrounding any given stand of white pine which must be cleared of Ribes in order to remove the danger of serious infection. After considerable discussion a resolution was adopted stating that, in the opinion of the committee, in view of the evidence so far available, pine stands themselves free from Ribes are not in danger of serious infection from a commercial standpoint, provided Ribes is eradicated from a zone one-third of a mile in width surrounding the pine stand. This distance is, of course, subject to revision on the basis of further investigation.

6. It was the consensus of opinion that the disease is now so firmly established in New England and New York, probably also in Ontario, as to make its eradication out of the question. In these regions, therefore, it is now a question for each individual owner to decide what measures, if any, he desires to take for the protection of his white-pine stands. The character of the work undertaken by the Office of Forest Pathology in this region will hereafter probably be confined mainly to experiments to determine the best means of control and to experimental demonstrations in a few places on a comparatively large scale.

In the Lake States the disease is now more widely distributed than it was a year ago, particularly in the valley of the St. Croix River, but hope of eradicating it in this region has not yet been abandoned. Here the work of the Office of Forest Pathology will probably continue along the old lines of scouting and control measures.

No evidence has yet been found to indicate that the disease has obtained a foothold in either the white-pine or sugar-pine region.

7. The committee seemed to be uniformly of the opinion that the white pine is a sufficiently valuable crop to justify control measures, and that the work of eradication and control should be vigorously continued. The adoption of correct silvicultural practice in the handling of white-pine stands was urged as one means of control that should receive more attention than heretofore. The committee adopted a resolution urging the Federal Government to continue its present appropriation for fighting the disease.

8. A resolution was adopted urging Congress to pass a law prohibiting the importation of nursery stock as defined by the Plant Quarantine Act of 1912, with the provision that the Department of Agriculture might arrange for the importation and distribution of any plant material that appeared to be of value for use in this country. The wording of the resolution as adopted would not prohibit the importation of forest-tree seeds under the same conditions as at present.

The secretary of the committee was requested, if practicable, to make arrangements for printing the proceedings of the conference in con-

densed form, including one or two of the more important papers presented. This publication, which may be made either in the form of a separate pamphlet or through some magazine, or possibly both, will make permanently available for reference the more important facts brought out by the meeting and the exact resolutions adopted.

In connection with the resolutions adopted at the Pittsburgh conference, it may be of interest to state also the conclusions reached at the conference of State and Government men actively engaged in co-operative blister-rust work in the New England States held at Amherst, Mass., July 17 and 18:

1. The essential thing in controlling the blister rust is to get out all Ribes. The most effective time for doing this is in the early spring, and this part of the season should be used for rescouting control areas.

2. It is not feasible to spend time and money in scouting and eradicating diseased pine in New England, except where there may be outbreaks of the disease in new territory.

3. The establishment of control areas, in which all Ribes, both wild and cultivated, shall be eradicated as far as possible, is regarded as the most practicable means of limiting the ravages of white pine blister rust; and owners of pine woods are urged to co-operate with State authorities to control the disease in their several localities.

4. In the expenditure of funds appropriated for blister-rust work, the conference approved: (*a*) The method of direct State experimental areas to determine the cost of control by means of the eradication of wild and domestic Ribes under various conditions; and (*b*) Such co-operation with private owners as will give expert direction or supervision to their work.

5. Localities established as control areas should be scouted at least four successive years for Ribes.

6. Men inspecting should be required to carry whisk brooms and to brush their entire clothing with these after dipping them into disinfectant when circumstances require; also thoroughly to wash their hands and arms.

Discussion at the conference made it clear that in the generally infected New England territory, inspectors should not be required to wear a special uniform which has to be sterilized frequently. One objection to this is that such a suit would have to be sterilized many times each day, possibly 30 or 40 times, causing inconvenience and great delay. An even more important consideration, however, is the danger of poisoning, or at least of severe skin irritation, by the strong antiseptics used, and this risk does not appear to be warranted by the conditions in New England. Also, it has been found that the antiseptic which is most highly recommended, corrosive sublimate solution, will not penetrate into the interior of spore masses because of the film of air surrounding them. Strong ammonia water not only penetrates spore masses readily, but is an effective agent in devitalizing the spores. Inspectors are most likely to carry the spores on their hands and arms. By keeping their shirt sleeves rolled back when examing Ribes, it is a simple and harmless operation to first wet the

hands and arms with pure water and then rub them well with about a teaspoonful of strong ammonia water and immediately wash this off in clear water after making the inspection. Also, since such spores as reach the clothing must adhere rather loosely in order to be in danger of carrying the disease to uninfected plants, it is believed that the chances of spreading the disease on the clothing will be very small if after each inspection of infected plants the clothing is brushed with a wisk broom moistened with strong ammonia water.

Naval stores operators can obtain about 30 per cent more turpentine and 35 per cent more rosin than is generally obtained from trees by increasing the number of chippings during the season to twice a week instead of once, the streaks being cut, however, only ¼ inch instead of ½ inch high, the present standard, the end of the season thus showing the faces no higher than when ½-inch streaks are cut once a week. This method of operation has been tried by the Forest Service on a tract in Mississippi. The report on the experimental work states that, taking all additional expenses into account, and in the light of 1916 prices, double chipping should increase the net profits from a turpentine crop of 10,000 faces by about $450, the increase from a 50-crop operation yielding about $22,000. Experiments cannot, however, give sufficient data to show the effect of this system upon the trees in the second and subsequent years. In cases where the trees are to be cut in a year or two, this method of chipping should be especially advantageous, but indications are that it would cause a severer strain upon the vitality of trees than ordinary methods.

Western Conservationists and Pacific Loggers

The Western Forestry and Conservation Association and the Pacific Logging Congress held their annual meetings in Seattle during the week of October 15. The first two days were given over to a joint meeting of Federal, State, and private forest officers and timberland owners for the consideration of questions pertaining to forest-fire protection, the third to the Annual Forest Industry Conference, and the last three days to the Pacific Logging Congress. A feature of special interest in connection with the forest-fire conference was the report of the "Committee on Standardization," whose purpose has been to standardize the business systems, forms, and reports of the various co-operating organizations. Other important topics discussed included problems

involved in connection with lookout stations, telephone construction, topography and relief maps, and temporary labor. Mess kits, water-bags, force-pumps, the Osborn fire-finder, maps, and especially constructed tools of various kinds were on exhibition.

The report of Forester E. T. Allen, of the Association, shows the extent of the protection work in the five Northwestern States. During the past year 95,310,000 acres were under patrol by the affiliated organizations. The expenditures for protection amounted to $1,825,187. The merchantable timber area burned over was 293,784 acres, with 445,822,000 feet of merchantable lumber killed, but of which only 131,716,000 feet were lost beyond salvage. Sixteen lives were lost and property losses other than timber were estimated at $1,786,000. The total cost of forest fires during the year, including expenditures and losses, was nearly $4,000,000. These figures show the very marked progress in forest-fire control—1910, 1914, and 1917 were closely alike in fire hazard. The loss in 1910 was about $3,000,000,000.

The chief points discussed at the forest industry conference, which was largely in the nature of a business meeting of the Association, included (1) the advisability of affiliating with the National Lumber Manufacturers' Association; (2) of enlarging Mr. Allen's work by keeping him at the National Capital during the period of the war to consult with and advise the various government officials in connection with the relation of the lumber industry on war problems; (3) the importance of urging the organization of a spruce regiment as a solution of the difficulties standing in the way of meeting the government's demands for airplane stock. It was recommended that the trustees take such action as is necessary to bring these three items to a head. A very able paper by Dr. Wilson Compton, of the Federal Trade Commission, was read concerning the responsibility of the lumber industry in the war. In this he indicated that if the lumbermen could not supply the needs of the government it might be necessary for the government to take over the industry.

The Logging Congress devoted one day largely to logging engineering, including discussions on technical logging problems and to the education of logging engineers. Friday was given over to a consideration of general welfare work at the camps, such as accident and fire prevention, sanitation, labor, and cook-house problems, and Saturday an inspection trip was made over the operations of the Admiralty Logging Company's camps.

A problem of special interest to technical foresters is the emphasis that was placed on the importance of increasing the use of technical

men in connection with nearly all phases of forest and lumbering work. At the fire conference sessions it was brought out that students are superior to ranchers and laborers for lookouts, and in fact nearly all protection work, because of their special training and their greater interest in the work. At the Logging Congress the need for further developing the work of logging engineering and lumbering as it is being taught at the forest schools, so as to make the graduates of use in other than merely the specialized technical engineering problems, was emphasized.

Logging Industry in the Pacific Northwest

The logging industry in the Pacific Northwest of a decade ago, as a rule, was conducted in a very conservative way, with few attempts to experiment with new methods and little encouragement given for new ideas. The system of logging by which the logs were hauled from the stump to the railroad by means of a donkey engine and then transported from the forest by logging railroad had by that time, of course, superseded the older method of bull-team logging. This system was steadily improved from time to time, but no basic changes in machinery or method of operation were made for several years.

During the last half decade, however, great changes have been made in every department of the work, especially among the more progressive operators. High-lead logging is supplanting the former ground system; long hauls over pole roads are largely being eliminated; well heated, lighted, and ventilated bunk-houses are to some extent taking the place of the old crowded, insanitary sleeping quarters; logging engineers are planning operation in advance, and in no part of the operation has there been lack of improvements. The Pacific Logging Congress has been a very great factor in this transition through the medium which it supplied for the discussion of advanced ideas in the design of machinery and improved methods of operation. The congress has also been a great factor in the establishment of departments at the universities of the West for the technical training of men for the industry. The universities have already begun to turn out men whose influence will be felt along the line of efficiency and more logical planning of operations.

That there is need of further improvement cannot be gainsaid, but in some instances the pendulum has swung too far the other way, and the logging operator has taken up with things which have later proven unprofitable. For example, during the last three or four years many

concerns have installed on their donkey engines burners and the apparatus necessary for the use of crude oil instead of wood as a fuel. It was evident that oil costing less than $1 per barrel was a very much safer, cheaper, and more efficient fuel than wood. Now, however, that crude oil has doubled in cost and, due to the enormous demand for gasoline in Europe, is practically impossible to obtain, wood will again have to be used and the oil-burner equipment discarded. The high-lead system of logging is being adopted very widely, but whether it is a method which will replace ground logging or overhead cableway logging, under all conditions, remains to be seen. However, it is far better that an industry be progressive and alive to new ideas rather than stagnant and ultra-conservative, for it is only through experiments and failures that feasibility of innovations can be tested.

E. T. C.

Forestation of the Virgin Islands of the United States

The island of St. Thomas, which is about 12 miles long and three to four in width, has practically no trees that could be used as saw timber. It is said that at one time the island was heavily forested with tropical hardwoods, but that these were burned off in order to make room for crops. The island was cultivated until 1848, when slavery was abolished. Since then it has not been profitable to produce crops there, because its mountainous character makes the use of modern farm machinery impossible, while the unlimited labor supply is no longer available. The island is also now subject to droughts.

I rode all over the island on horseback. It is a mountain top rising steeply out of the sea. The western slope was swept almost clear of vegetation by the hurricane of last October and looks somewhat like the hill country of New Mexico. The eastern slope is covered with a very dense growth from 6 to 20 feet in height. Along the watercourses a few trees 30 feet high are seen, and I found one grove of such trees a few acres in extent near the highest part of the island. The opens support a rich forage of guinea-grass and a few cattle are raised. Cultivation is limited to a few scattering patches of yams, a few banana trees, and cocoanut palms. Wild life includes deer and goats, both introduced, parrots, wild pigeons, and the Indian mongoose.

St. Johns is the best watered of the three islands; but it, too, is almost entirely uncultivated because of its mountainous character. It is distinguished by its groves of sweet bay trees, from which the West Indian bay rum is made. There are a few lime orchards. The rest of

the island is covered by the same low, dense brush that is found in St. Thomas, the growth being even more luxuriant here; but so far as I could learn or observe, there were few larger trees. The only use made of timber in either of these islands is for fuel, much of it being burned into charcoal in crude ovens.

St. Croix is a little larger than either of the other islands, and belongs to a different group and is of a different geological formation. One side of the island is a flat lowland, while a small but steep mountain range lies upon the other. The lowland is all under cultivation, mostly in sugar cane. Here a number of large trees grow along the roads and in the watercourses, and one group of very high and stately trees was pointed out to me as mahogany. Most of the mountain country is covered merely with brush.

On St. Johns, I was told, the people burn the brush and plant the land in guinea-grass when they are not engaged in gathering bay leaves. It may be safely said that nearly all of St. Thomas, the greater part of St. Johns, and much of the hill land in St. Croix are waste lands and will never be used for anything except grazing. It is also reasonable to suppose that they will support forests, as they have done so before. They are picturesque and healthful and support an interesting wild life despite a complete absence of protection.

Harvey Ferguson.

In a competition last April between teams representing ten rifle clubs in the Department of Agriculture, the Forest Service Rifle Club won first place and the prize—a star-gauged Springfield rifle. Though seriously depleted through the acceptance by 20 per cent of its members of commissions in various branches of the military service, the club is still active. From among the 65 members of the club there have been commissioned and called to active service a lieutenant-colonel, two majors, six captains, and two first lieutenants. The organization of the club and the maintenance of its activity are largely due to its executive officer, Mr. Reynolds.

Settlement of Ex-Soldiers in Canada

An Empire Settlement Committee for Great Britain was charged last February to report on measures for settling ex-soldiers in various parts of the empire. It has compiled the various government schemes now in existence. In Canada the following arrangements exist:

	Dominion Lands	New Brunswick	Nova Scotia	Quebec	Ontario	British Columbia
Extent of individual grant:	160 acres in Manitoba, Alberta, Saskatchewan.	10 to 160 acres.	Private farms for sale.	Land offered in lots of 100 acres.	160 acres.	Not yet fixed.
Conditions:	Free.	Cost governed by cost of improvements (clearing, well, house).	Cost from $583.20 to $14,580.	$29.16 per acre, payment within 5 years.	Free, subject to conditions as to clearing, cultivation, and residence.	Pre-emption claim to land purchasable for $9.72.
Crops:	Wheat, mixed farming.	Dairying, fruit, and potatoes.	Mixed farming, fruit, dairying, stock-raising.	Heavily timbered land.	Root crops and hay.	Timbered, fruit crops, mixed farming.
Government loan:	$1,944 maximum.	$486 to $1,458.	Up to $2,430.	....	$486.	A fund to be provided.
Repayment:	In 15 years at 5 per cent.	10 per cent on application, balance within 20 years.	Secured by mortgage.	....	In 10 years at 6 per cent.	....
Whether previous experience necessary:	Yes.	Yes.	Advisable.	Yes.	Yes.	....
Training:	Dominion demonstration farms, or with approved farmers.	Demonstration farms.	Employment on farms.	....	Demonstration farm at Monteith.	....
Capital necessary:	None.	$486 to $1,944 desirable.	$1,458 necessary.	....	Not absolutely essential.	....
Other remarks:	Available also for widows of soldiers and sailors who have died in active service.	Community settlements to be established, accommodating 100 to 250 families, with church, public hall, school, etc.	Government will assist in choice of farm and employment, in order to gain experience.	Suitable only for native-born Canadians. Within 5 years settler must clear 15 acres, build house, and put up barn.	Men without experience will be trained at Monteith farm at a reasonable wage; and subsequently a farm colony will be established along one of the railways.[1]	....

[1] The Dominion Government has also announce' its intention of giving financial assistance to any approved settler on other than Dominion lands in any province of the Confederation.

Government Protects O. & C. Land from Fire

For the past three years the Government has been expending approximately $25,000 annually for the protection of the timbered tracts of O. & C. land from fire, the work being done under the supervision of the Forest Service. The O. & C. lands inside the boundaries of the National Forest are patrolled directly by the Forest Service field force, while the lands outside the National Forests are patrolled in co-operation with the private fire patrol associations and with the State Forester.

The State of Oregon has a compulsory patrol law requiring every owner to furnish fire protection for his timber holdings. In the past the Government has paid its share for the protection of the O. & C. lands in proportion to the acreage in each county, the same as the timberland owners throughout the State. Since the beginning of the suit, there has been but very little timber destroyed by fire.

According to the terms of the Chamberlain bills, the proceeds from sale of timber on the O. & C. lands will be used to pay the back taxes to the counties in which the land is located; also a certain portion of the net receipts goes to the irreducible State school fund and the counties in which the land is located.

The loss of timber on O. & C. lands, therefore, not only means a loss of wages to the people of the State, but also a direct loss in the stumpage value. For this reason the O. & C. lands are protected for the people.

Those who think that forestry conditions in India are comparable to ours may have an interest in the description of intensive silviculture in the North Kanara Division:

"In the month of June of each year the guards and coupe mali (a cooly, termed a coupe mali, is allowed for each newly exploited coupe) go through each newly exploited coupe and mark each teak seedling by fixing a teak-wood stake 3 feet high firmly in the ground on the west side of the seedling and one foot distant from it. This stake not only marks the plant, but is used later on for supporting a grass shelter which shades the seedling.

"As soon as the seedlings are marked with stakes, a space of 1½ feet round each plant is weeded and the earth slightly loosened. Weeding is done at least once a month throughout the rains.

"During October and November the teak seedlings are earthed up with loose earth for a space of 2 feet round each. During December grass shades are placed on the stakes to shade the seedlings. These shades are removed in April and the grass is placed round the base of the seedling.

"In addition to this work, small local nurseries are made, and the seedlings from these are transplanted in the month of July into blanks where no natural seedlings are to be found. Only 15-months-old plants are transplanted.

"In the second year the plants, formerly marked, are again inspected, weeded, and blanks caused by the death of the previous year's plants are filled up.

"In the third year the area is once again gone over and plants in danger of being smothered by grass are cleared. After the third year the plants are left to themselves, as by this time they have got a good start and are able to compete with the grass."

Only an abundance of cheap labor renders such silviculture possible.

The Yale School of Forestry has issued a small pamphlet referring to its course of research and instruction in tropical forestry. It is stated that there are at least two very large forest regions in the tropics. These are the Amazon region of South America and the Indo-Malay region of southeastern Asia and adjacent islands. The forested region of the Amazon River basin, comprising an area of 1,600,000 square miles, is the largest in the world. The forested area of Borneo, Sumatra, the Philippine Islands, the Malay Peninsula, and Burma is roughly estimated to be not less than 500,000 square miles, or nearly as large as that of the United States. Thus the forested area of these two tropical regions alone comprises more than 2,000,000 square miles. Contrary to the usual opinion, it is claimed that tropical forests are not all composed of hard woods fit only for special purposes, but that they have a much larger percentage of soft and medium hard woods, which it is quite practicable to develop economically.

What is needed is public appreciation of the value of the undeveloped forest resources and of the possibility of making them a permanent asset. This can be brought about by expert foresters, who will not only direct operations in the woods, but also arouse the public to the need of forest conservation, and assist in the formulating of a proper forest policy and in the enactment and enforcement of suitable legislation.

The work proposed falls under two heads: (1) Instruction; (2) Investigation. Each of these headings has been divided into three different branches, as follows:

(*a*) Tropical Silviculture and Dendrology.

(*b*) The Technical Properties and Uses of Tropical Woods.

(*c*) Trade Information and Methods of Forest Utilization.

Dr. H. N. Whitford, with H. M. Curran, will cover the first subject,

both in instruction and investigation; the second is in the hands of S. J. Record; the third will be handled by R. C. Bryant.

The most important news to report for Missoula District is the result of the fight with the fires during the season 1917. This was a pretty good test of the fire-fighting machinery which has been developed. The season was worse than any since 1910 and in a great many respects climatic conditions were less favorable. The records show that for 1910 the length of the dry spell—that is, the period during which not to exceed .1 of an inch of rain fell at any one time—was 66 days; for 1914, 62 days, and for 1917, 93 days. The results under these severe conditions are very encouraging. At no time did the organization break down. Certainly it was strained at a few points and for short periods, but on the whole its integrity was not threatened at any time. The following are some of the preliminary figures, which may be changed upon compilation of more careful and final figures: Total number of fires, 1,422, divided as follows: Class A—that is, less than one-fourth acre, 654; Class B, one-fourth to not more than 10 acres, 401; Class C, anything over 10 acres, 367. Total area burned over, 236,000 acres. Merchantable timber, 67,000 acres; young growth, 134,000 acres; old burn or barren, 35,000 acres; M feet merchantable timber, 214,000,000. This represents 13/200 of 1 per cent of the total area in District 1 and 4/10 of 1 per cent of the total merchantable timber. Causes are reported as follows: Railroads, 317; brush burning, 179; campers, 253; lightning, 185; incendiary, 190; all others, 398.

During the 1917 fire season the Missoula fire department was called out to protect the town of Lolo Springs, which was threatened by one of the largest forest fires. The department sent an automobile, to which a pump was connected, which would throw two large streams of water. The fire fighters saved the town, so that it was unnecessary to use the apparatus in protecting the building, but it was used to very good advantage along the wagon road between the Springs and the Bitterroot Valley. The wagon road was used as a fire line for about five miles of its length. This automobile apparatus was used to throw streams of water on the dangerous pieces of fire as it backed down to the road. There are a great many fires which can be reached from automobile roads, and it might be well worth while to have one or more such fire-fighting apparatuses brought into service to a larger extent.

The labor situation in the Missoula District has not very much improved. Apparently it has improved in a certain sense—that is, that the lumbermen and the lumber workers seem to be nearer to an understanding than formerly—but the results have not yet begun to show in a larger output of logs. As an example of the curtailment of woods operations, the Forest Service during the first two months of the fiscal year 1917—that is, July and August—cut 17 million, as compared with 35 million for the same period last year. The receipts of timber sales were $33,000, as compared with $95,000 for the same period last year. The Cœur d'Alene Forest, for example, cut this year 3 million during this period, as compared with 10 million feet last year. A favorable sign is the action which some of the lumbermen have already taken. For example, the Montana Lumber Manufacturers' Association has agreed to a certain standard of camp buildings and camp sanitation, and they expect to enforce their standards by the employment of an inspector, who will report directly to the Association.

The State of Michigan now owns 540,000 acres of land. It is proposed to plant at the rate of 4,500 acres by the Public Domain Commission—*i. e.,* for a 60-year rotation for one-half the acreage. One-half of the remaining half is expected in 30 years to produce wood materials to clear $15 per acre at the rate of 4,500 acres per annum to be replanted. Sixty years hence the remaining 135,000 acres will be treated. The initial restocking will then be completed by the year 2007.

Acorns for stock-feeding are discussed in England, especially for sheep and pigs, when two pounds per head per day is a satisfactory allowance. For fattening cattle three or four pounds is allowed; less for milch cows. Indiscriminate feeding of acorns, however, is dangerous. Horse-chestnuts are also collected by organized service of school children.

The U. S. Weather Bureau has organized a new division of agricultural methods, whose function it will be to correlate weather and crop production. A similar undertaking has been inaugurated in the Canadian Meteorological Bureau, with a former forester, Eric McDougall, in charge. Silviculture will, no doubt, also benefit by these investigations.

The "tree-cross," an improved Biltmore stick, perfected by Prof. E. T. Clark, of the University of Washington, is claimed to be more

practicable than the tree caliper or regular diameter tape for determining diameters of standing trees, especially of large diameter. It differs from the Biltmore stick in that the sliding graduated cross-bar is held on a pole at exactly 45 inches from the tree to be measured. The pole extends past this point just 15 inches, so that as the tree-cross is held against the tree with one end on the cheek below the eye of the observer, the two triangles formed by the pole, the stick, and the tree are always in exact proportion. Any possibility of error is thus avoided.

Pennsylvania spent $2,275,000 in acquiring one million acres of forest land. Due to rise in timber values, this land is estimated to be worth now six million dollars.

Over 14 million dollars have been spent to get rid of the gypsy moth in Massachusetts and adjoining States.

Approval has been given by the Washington State Land Board for exchange of 250,000 acres of government land in the east side National Forests for school lands in the forest reserves. About an equal amount of land is to be chosen in western Washington from the Olympic and the Snoqualmie Forests.

On May 3, 1917, Sweden's new Forest School and State Forest Experiment Station buildings, which had been under construction since the fall of 1915, were formally dedicated. Both are fine modern buildings, located close together on a 12-acre tract just outside of the city of Stockholm. In addition to the usual lecture-rooms, laboratories, library, etc., the forest school contains a number of museum rooms, in which are some unusually fine exhibits pertaining to forestry and closely allied subjects. Both the forest school and the experiment station have been badly in need of more adequate quarters, and the new buildings which have now been placed at their disposal should add much to their efficiency. The importance which is attached to these institutions in Sweden is indicated by the fact that the dedication exercises were attended by the King and other members of the royal family, representatives of various government departments and institutions of learning, and delegates from Denmark and Norway.

The legislature of Pennsylvania has increased the biennial appropriation for the State Forest Department by 30 per cent over that made in 1915, so that it now amounts to $807,000. The increase is mainly in appropriation for forest protection and labor (planting), and for purchase of land, for which $130,000 is provided. The Forest Academy at Mont Alto also receives an advance to $25,000.

The Canadian Lumbermen's Association, the Canadian Forestry Association, and the Canadian Forest Protection Association will hold their annual meetings in Montreal during the first week of February, 1918.

More than two-thirds of the technical foresters in Canada in 1914 have seen military service at the front. The enlistment of forest rangers has likewise been heavy.

From an account in the *Canadian Textile Journal,* October, 1917, describing the manufacture of paper fiber rugs by a company at Neenah, Wis., we learn that not only durable rugs in usual sizes are made from tissue paper twisted into threads, but also hall runners, bath mats, and any variety of floor coverings.

Announcement is made that the subscription price of the *Journal of the Washington Academy of Sciences* is $2.50 per year to members of the affiliated societies, or $2 per year if 25 or more members subscribe through the sceretary of their society. The regular subscription price is $6 per year. Subscriptions should be sent to the treasurer of the Academy, Mr. William Bowie, U. S. Coast and Geodetic Survey, Washington, D. C. This journal publishes announcements of all meetings of the scientific societies of Washington and reports their proceedings, giving brief abstracts of the papers presented and of the discussions.

PERSONAL

1. *Northeastern United States and Eastern Canada*

W. Boyd Evans has been appointed a member of the teaching staff of the Pennsylvania Forest Academy.

H. R. MacMillan, formerly Chief Forester of British Columbia, has resigned his position as Assistant Manager of the Victoria Lumber & Manufacturing Company to undertake the location of stands of British Columbia spruce adapted to airplane manufacture, under the Imperial Munitions Board.

J. D. Lamont, recently in the employ of the Forestry Division of the Indian Office, has accepted a position with the Delaware & Hudson Railway Company at Plattsburg, N. Y.

Cedric H. Guise (M. F., Cornell, 1915) is secretary of the Alumni Association of Cornell Foresters, a new organization which includes in membership all who have studied or taught forestry in Cornell, either in the old school or in the present department.

Alfred Hastings is Acting State Forester of New Hampshire during Hirst's absence abroad.

Cornell Foresters in War

COMMISSIONED AS OFFICERS AFTER DUTY AT RESERVE OFFICERS' TRAINING CAMPS

S. G. Smith (1905), Second Lieutenant, Company L, 302 Infantry, National Army.

G. M. Taylor, M. F., '17, Second Lieutenant, 2d Engineer Officers' Training Camp, Ft. Leavenworth, Kans.

D. C. Thompson, B. S., '17, Second Lieutenant, Mobilization Camp, Ayer, Mass.

H. F. Tilson, B. S., '17, Second Lieutenant, 2d Provisional Regiment, 165th Depot Brig., Camp Travis, Tex.

TENTH ENGINEERS (FOREST)

H. B. Steer, M. F., '15, Company E.
W. H. Doggett, B. S., '16, Company C.
F. H. Miller, B. S., '16, Company E.
E. Frey, B. C., '17, Company C.
G. S. Kephart, B. S., '17, Company E.
Edgar Myers, B. S., '17, Company B.
R. E. Perry, B. S., '17, Company F.

Address: 10th Engineers (Forest), American Expeditionary Forces, via New York

TWENTIETH ENGINEERS (FOREST)

R. C. Bryant, F. E., 1900, Commissioned as Major.
T. F. Luther, Sp., '16.
B. A. Eger, '18.

Applications Pending

R. G. Bird, B. S., '16.
L. W. Gebo, B. S., '16.
R. S. Green, '19.

AVIATION

H. E. Irish, B. S., '16, Aviation School, Princeton, N. J.
L. G. Brower, '18.
R. B. Woodleton, '19, Aviation School, Ithaca, N. Y.

IN U. S. ARMY OR AT SECOND RESERVE OFFICERS' TRAINING CAMPS

J. H. Coyne, Jr., B. S., '15, Yaphank, Long Island, N. Y.
R. L. Hoag, B. S., '15.
G. S. Rhodes, B. S., '16.
A. G. Katz, '17.
Alfred Reed, Jr., '17.
F. E. Forbes, '18.
A. P. Jahn, '18, Medical Dept., Prov. Battalion of the 16th Infantry, Mobilization Camp, Syracuse, N. Y.
J. H. Lay, '18.
L. V. Lodge, '18.
F. B. Merrill, '18, Musician, Headquarters Co., 49th Infantry, Tenafly, N. J.
Mark Owens, '18.
Theis Roberts, '19, New York National Guard.
G. B. Moffat, '20, New York National Guard, Squadron A (Artillery).

NAVY

E. I. Kilbourne, B. S., '17 (Ensign).
S. H. Sisson, B. S., '17 (in the Mediterranean).
I. H. Bernhardt, '18.
G. B. Gordon, '19, 1st Battalion, N. Y. Naval Militia (seaman 2d class).

NAVAL RESERVE

W. D. Comings, B. S., '17, Newport, R. I.
* Perkins Coville, B. S., '17.
B. D. Dain, B. S., '17, Newport, R. I.
J. S. Everitt, B. S., '17, New London, Conn.
R. M. Gavett, '18, Newport, R. I.
D. K. Hendee, B. S., '17, Newport, R. I.
* R. B. Hine, '19.
H. O. Johnson, B. S., '17, New Bedford, Mass.
W. B. McGrew, B. S., '17, Newport, R. I.
A. A. Manchester, '17, Newport, R. I.
F. B. Rose, '17, New Bedford, Mass.
A. C. Shaw, B. S., '17, Newport, R. I.
R. L. Skinner, B. S., '17, New London, Conn.
R. H. Wheeler, B. S., '17, Newport, R. I.
W. W. Jeffrey, '19, Newport, R. I. (Ensign).
* E. M. Prellwitz, '19 (now landscape art).
F. J. Tapley, '19, New London, Conn.
* W. E. Wright, '19.

AMERICAN FIELD AMBULANCE CORPS—CORNELL UNIT, IN SERVICE IN FRANCE

E. I. Tinkham, B. S., '16; S. C. Garman, B. S., '17, in charge of sections. (Tinkham has transferred to U. S. Naval Aviation Corps. Address: U. S. Naval Aëronautic Detachment No. 1, 23 Rue de la Paix, Paris, France.)
J. D. Loughlin, B. S., '17, Address: Care American Field Service, 21 Rue Raynouard, Paris (XVI), France.
C. W. Comstock, '18.
A. A. Baker, '19.
Walker Smith, '20.

INDUSTRIAL WORK IN CONNECTION WITH THE WAR

W. D. Crim, B. S., '17, Government Aviation Camp, Millington, Tenn., Lumber Inspector for Signal Corps.
A. D. Honeywell, '19, Curtis Aviation Works, Hammondsport, N. Y.

Of the above 63 men, 52 were enrolled as students in the Department of Forestry last April, the total registration at that time being 110.

* In residence at the University, subject to call.

2. *Central United States*

H. D. Tiemann is the author of a book, "The Kiln-Drying of Lumber," published by J. B. Lippincott Co., Philadelphia.

E. G. Cheyney had a roving commission from the government this summer in a study of the white pine blister rust in New England.

3. *Northern Rockies*

E. C. Rogers has taken a leave of absence in the Forest Service to enable him to attend the Graduate Department of Johns Hopkins University. Mr. Rogers has for some years been engaged in research work in planting and at the University he will devote most of his time to studies in plant physiology.

D. R. Brewster is now at the Presidio Training Camp. His work in management studies will probably be discontinued, at least until next summer.

District Forester F. A. Silcox was called to Washington early in August to help out with National Defense work. He has received a commission as a captain in the 20th Engineers (Forest). Since then he has been transferred to the Department of Labor, to act as its representative in labor matters connected with getting out spruce for airplanes and other timbers for ship construction.

R. R. Fenska, who left Wyman's School of the Woods on September 10 to accept a position on the faculty of the University of Montana Forest School at Missoula, will, in addition to scaling, cruising, and lumbering, offer courses in utilization.

4. *Southwest, Including Mexico, Central and South America*

Gordon T. Backus, Forest Examiner, has been transferred from the Coconino National Forest to the Santa Fe National Forest.

The death of Forest Ranger Charles E. Simpson, formerly on the Carson National Forest, occurred "somewhere in France." He was one of the first to volunteer for duty with the 10th Engineers (Forest). According to the dispatches, he died of cerebro-spinal meningitis, either on shipboard or very soon after the regiment reached the Allied territory. Mr. Simpson's home was in Williamsport, Pa. He was a graduate of Pennsylvania State College and has received a technical training in forestry. He was employed in a temporary capacity for three months in the summer of 1915, at the Feather River Experiment Station in California, and from September 1, 1916, to July 12, 1917, served as a forest ranger on the Carson Forest, being assigned to timber sale work. His record was one of accomplishment and indicated a most promising future for him in his chosen field of work. His loss will be keenly felt, but we must at the same time all take a conscious pride in the fact that his life was, in the truest and finest sense, literally given to his country in the time of her need.

5. *Hawaii, the Philippines, and the Orient*

Arthur F. Fischer, as dean of the forest school at Los Banos, P. I., recently graduated a class of 21 native rangers, and as director of forestry welcomed them into the forest service of the Islands.

SOCIETY AFFAIRS

In the last issue of the JOURNAL attention was called to the coming meeting of the Society of American Foresters at Pittsburgh, Pa., in conjunction with the American Association for the Advancement of Science. The date of this meeting has now been definitely set for December 31, 1917, and January 1, 1918. On the first day, from 10 a. m. until 1, the Society will hold a joint session with the Ecological Society of America. The program, so far as it has been at present completed, is shown below:

Forestry and the War—(20 minutes)........................Dr. B. E. Fernow
The Economic Basis of Recreation Forests.................Prof. R. S. Hosmer
Some Social Aspects of Forest Management..................Benton MacKaye
Increasing the Consumption of Fuelwood as a National Economy...A. F. Hawes
Some Observations on the Starch and Fat Content of Trees...Dr. E. W. Sinnott
A New Field for Forest Investigations..................................R. Zon
Methods of Increasing the Final Value of Mixed Second Growth Stands by Early Improvement Cuttings..........................Prof. R. T. Fisher
Some Ecological Notes on the Forests of Southeastern Iowa..Dr. L. H. Pammel
Prof. G. B. MacDonald
The Organization and Purpose of the Forestry Committee of the National Research Council..I. W. Bailey
The Significance of Transpiration in Forestry......................C. G. Bates
Aspen Reproduction in Relation to Forest Management.............F. S. Baker
Jacobson's New Seed Germinator *versus* the Sand Method.........J. A. Larsen
Height Growth as a Key to Site..........................E. H. Frothingham
Forestry and Agricultural Development in the South............W. R. Mattoon
Some Biologic and Economic Aspects of Chaparral................E. N. Munns
The Relation of the Forest Products Laboratory to Forestry......O. M. Butler
Climate and Plant Growth in the Wasatch Mountains of Central Utah—(20 minutes).....................................Arthur W. Sampson
The Rôle of Artificial Regeneration in the Re-enforcement of Hardwood Woodlots—(15 minutes)................................Edmund Secrest
Height Growth Behavior of Young Trees—(10 minutes).............J. S. Illick
A Practical Reforestation Policy—(15 minutes)...............George A. Retan
The White Pine Blister Rust as a Factor in Forest Management—(15 minutes)...E. G. Cheyney
Native Vegetation as a Criterion of Site........................C. F. Korstian
Check Dams as a Means of Controlling Floods in Southern California
E. N. Munns

The headquarters of the Society will be at the William Penn Hotel and of the Ecological Society at the Fort Pitt. The latter Society will

hold an informal dinner on the evening of December 29, and on December 30 is planning a "Conversazione," to both of which entertainments a cordial invitation is extended to all foresters present. It is earnestly hoped that a number will be able to avail themselves of this opportunity.

In order that the permanent addresses of members of the Society and subscribers to the JOURNAL OF FORESTRY may be kept up to date, those having changes of addresses are requested to notify the Secretary of the Society, 930 F street, Washington, D. C. Without such direct notice the Secretary has no authority to make changes in the addresses. It will be of great assistance, therefore, if each one will bear this in mind and send in prompt notice of any change.

Mr. D. T. Mason, who was elected to the Executive Council for a term of two years, has found it necessary to submit his resignation from the Council on account of his having received a commission in the Officers' Reserve Corps. The Council has, by unanimous vote, selected Mr. J. H. Foster to succeed Mr. Mason.

The attention of Society members is directed to the provision retained in Sec. 3, Art. V, of the revised constitution printed in this issue, whereby other nominations for the offices of the Society and for the Executive Council than those submitted by the Nominating Committee may also be submitted to the membership on the official ballot if indorsed by at least ten Senior members or Fellows and presented to the Secretary in writing at least four weeks before the annual meeting. This provision was framed for the purpose of affording the membership opportunity to make additional nominations if such nominations seem desirable.

Constitution as Amended to Date

ARTICLE I

NAME

The name of this Society shall be The Society of American Foresters.

ARTICLE II

OBJECT

The object of this Society shall be to further the development of technical forestry and the interests of the profession of forestry on the American continents by encouraging achievement in the science of forestry, by creating opportunity for an interchange of views upon forestry and allied subjects, and by fostering a spirit of comradeship among foresters.

ARTICLE III

MEMBERSHIP

Section 1. Except as specified for honorary membership, members of the Society shall be residents of the United States, or its possessions, or of Canada, or some other part of the American continents. Its membership shall consist of:

(1) *Members,* who shall be—

a. Men who have completed not less than four years of college work leading to a degree in forestry, or its equivalent in technical forestry training; or

b. Men without collegiate training in forestry who have completed at least three years' work of a creditable character in some branch of forestry.

Candidates for membership must be recommended for election to the Society by at least three Senior Members or Fellows.

Members may attend all meetings of the Society and take part in its discussions, but shall not be entitled to vote.

(2) *Senior Members,* who shall be foresters engaged in forest work and—

a. Who have completed technical training in forestry at a forest school of recognized standing, together with at least three years' work of a creditable character in some branch of forestry; or

b. Who have, in the absence of technical training in forestry, completed at least five years' work in some branch of forestry, who have been Members of the Society for at least two years, and whose work is regarded by the Executive Council as of an especially creditable character.

Senior Members shall have the ballot in all Society matters and shall be eligible to all of its offices and committees.

(3) *Fellows,* who shall be elected only from the grade of Senior Member. Fellows shall have completed at least ten years' work in some branch of forestry, including at least five years in responsible directive positions or in distinctive individual work of a fruitful character. They shall have the same rights as Senior Members.

Not more than ten Fellows shall be elected in any one calendar year. Nominations to this grade shall be made by seven affirmative votes of the Executive Council or by the written endorsement of 25 Senior Members or Fellows, and shall be submitted to all Senior Members and Fellows of the Society for letter ballot. An affirmative vote of three-fourths of the Senior Members and Fellows voting shall be necessary to election.

Should the candidates for Fellow receiving the vote required on the same ballot bring the total number chosen during a year to more than ten, elections to the grade shall be determined in the order of the number of affirmative votes cast, and those remaining shall be regarded as nominated for the ensuing year.

(4) *Associate Members,* who shall be persons engaged in lines of work related to forestry and who have shown substantial interest in American or Canadian forestry; but each section may elect associate members of the section in accordance with qualifications fixed by its own by-laws. (See Article VIII, Section 3.) Associate Members may attend all meetings of the Society and take part in its discussions, but shall have no vote.

(5) *Honorary Members,* who shall be chosen from those who have rendered distinguished service to forestry either in America or abroad, and from professional foresters of achievement whose field of work lies outside of the United States and its possessions and the Dominion of Canada. They may attend all meetings of the Society and take part in its discussions, but shall not be entitled to vote.

SEC. 2. The names of all candidates for *Member, Senior Member,*

Associate Member, and *Honorary Member* shall be submitted in writing to the Member of the Executive Council designated "In Charge of Admissions," accompanied by a biographical sketch, giving fully the qualifications of the candidate for admission to the designated grade of membership in the Society. The names of all candidates proposed shall be referred to all Senior Members and Fellows for comment or protest at least one month before final action is taken by the Executive Council. The Executive Council will then decide what candidates shall be elected, seven affirmative votes being necessary to admit any candidate to membership in the Society. When any candidate is not elected, the member of the Executive Council in Charge of Admissions shall notify the member of the Society by whom the candidate was proposed.

SEC. 3. Charges of conduct unbecoming a member may be preferred by a member of any grade. Such charges shall be made in writing to the member of the Executive Council designated "In Charge of Admissions," who shall investigate them without delay and submit his findings in writing, with the evidence upon which they are based, to the Executive Council of the Society for final action. A vote of at least seven members of the Council will be necessary to suspend, enforce the resignation of, or expel the member in question.

ARTICLE IV

OFFICERS

SEC. 1. The officers of this Society shall be a President, a Vice-President, a Secretary, and a Treasurer.

SEC. 2. The officers shall be elected, as hereinafter provided in Article V, Section 3, from the Senior Members and Fellows by letter-ballot at the first executive meeting of the calendar year, and shall serve one year, or until their successors are elected.

SEC. 3. The President shall preside at the meetings of the Society, shall appoint the committees hereinafter designated, and shall perform all other duties incident to his office.

SEC. 4. In the absence of the President, the Vice-President shall preside at the meetings of the Society.

SEC. 5. The Secretary shall keep the minutes of the Society, shall conduct its correspondence, shall announce its meetings, and shall be custodian of its permanent records.

SEC. 6. The Treasurer shall collect all moneys due the Society and have custody of all moneys received. He shall deposit and expend the latter only in such manner as the Executive Council shall direct.

ARTICLE V

COMMITTEES

SEC. 1. The Executive Council shall consist of the President of the Society as chairman *ex officio,* the Vice-President, Secretary, Treasurer, five other members elected by letter-ballot of the Society, one member being elected each year, who shall serve for five years, or until their successors are elected, and the Chairman of the Editorial Board. The latter shall be chosen by ballot of the elected members of the Executive Council and shall serve for one year, or until his successor is selected. The President shall designate yearly from the members of the Executive Council the Chairman of the Committee on Meetings and a member to be In Charge of Admissions. The other members of standing committees and the Editorial Board shall be appointed by the President, as hereinafter provided, and shall serve for one year, or until their successors are appointed.

SEC. 2. Five (5) members of the Executive Council shall constitute a quorum. The Council shall control the funds of the Society and shall discharge any other executive duties not specifically provided for otherwise in this Constitution. The Council shall have the power to fill any vacancies occurring in its number or in any office. It shall elect persons to membership in the Society, in each of the respective grades except Fellows, seven affirmative votes being necessary to admit any candidate to membership in the Society. The Executive Council shall receive and act upon the written report of the Member in Charge of Admissions on charges preferred against any member of the Society, a vote of at least seven members of the Council being necessary to suspend, enforce the resignation of, or expel the member in question. The Executive Council shall have the power, by vote of at least seven of its members, to draft and establish by-laws for conducting the affairs of the Society in matters not provided for herein, but no such by-laws shall abrogate or be inconsistent with any part of this Constitution. Appeal from any action of the Executive Council may be taken to the Society by obtaining the written concurrence of one-fourth of the Senior Members and Fellows addressed to the President.

SEC. 3. The Executive Council, before each annual meeting, shall appoint a nominating committee of three (3) Senior Members or Fellows of the Society, whose duty it shall be to make not less than two (2) nor more than three (3) nominations for each of the offices and for the members of the Executive Council. These nominations shall be submitted to the Senior Members and Fellows of the Society not

more than twelve (12) nor less than four (4) weeks before the annual meeting. Other nominations, if indorsed by at least ten (10) Senior Members or Fellows and presented to the Secretary in writing at least four (4) weeks before the annual meeting, shall also be submitted to the membership on the official ballot. The candidate receiving the highest number of votes for each office shall be declared elected.

SEC. 4. The Committee on Meetings shall consist of three Senior Members or Fellows, appointed by the President, one of whom, the chairman, shall be a member of the Executive Council. It shall select the speakers, subjects, and dates for meetings of the Society, as provided in Article VI, Section 4.

SEC. 5. The Editorial Board shall consist of a chairman, who shall be the Editor-in-Chief, chosen by ballot of the Executive Council, and eight (8) other Senior Members or Fellows, appointed by the President. Within this Board there shall be an executive committee consisting of the Editor-in-Chief as chairman and such other members as the President shall designate. The Board shall have charge of the official organ of the Society and shall decide all matters related to its publication. The executive committee shall consider papers read before the Society, or otherwise submitted to it, shall approve or reject them for publication, and shall transact the business necessary to that end.

ARTICLE VI

MEETINGS

SEC. 1. The Society shall hold an annual meeting, executive meetings, and open meetings.

SEC. 2. The annual meeting shall be held at a place and on a date to be designated by the Executive Council. It shall be for the transaction of business and for the presentation and discussion of professional papers.

SEC. 3. Executive meetings shall be open to members only, and shall be held at the call of the President, or, in his absence, at that of the Secretary. They shall be for the transaction of business and the discussion of any subject selected by the Executive Council.

SEC. 4. Open meetings may be attended by members and by guests of the Society, and shall be held as directed by the Committee on Meetings. The Society may hold such field meetings as the Executive Council or Committee on Meetings may direct.

SEC. 5. A quorum shall consist of seven (7) Senior Members or Fellows.

SEC. 6. Upon the order of either the Executive Council or a majority of the Senior Members and Fellows present at any meeting, any question shall be submitted to the membership for decision by letter-ballot.

ARTICLE VII

AFFILIATED ORGANIZATIONS

SEC. 1. Any local forestry society or club whose membership includes two or more Senior Members or Fellows of The Society of American Foresters may petition the Society in writing, through such members, for the enrollment of the society or club as an affiliated organization. If in the judgment of the Executive Council the membership and aims of the organization are of sufficiently high professional character, the Council shall grant said petition and the organization be enrolled as the.............................affiliated with The
(Name of organization)
Society of American Foresters.

SEC. 2. Affiliated organizations shall determine the qualifications for membership in them, but no rights or privileges belonging to Senior Members and Fellows in The Society of American Foresters shall be attained merely by membership in an affiliated organization.

SEC. 3. As a condition of affiliation with the Society, each affiliated organization shall, as a whole, pay the regular annual dues of the highest grade of membership, and shall receive one copy of all publications and communications of a public nature intended for members of the Society. The organization shall also elect one or more of the Senior Members or Fellows of the Society in good standing, who shall represent the organization officially and shall handle all business and correspondence between the Society and the affiliated organization.

SEC. 4. Papers delivered before any affiliated organization shall be the property of that organization and may be published in its official organ. The affiliated organization may offer for publication in the organ of the Society papers of a high professional or technical nature which have not already been published. These papers shall be subject to the approval of the Editorial Board, and if not approved for publication shall be returned to the organization in which they originated.

SEC. 5. The Executive Council shall have the right at any time to rescind the authorization for any affiliated organization and to terminate its connection with the Society.

ARTICLE VIII

SECTIONS

SEC. 1. To carry out more effectively the aims of the Society, Sections may be established wherever there are enough Senior Members or Fellows to form a strong local organization. The formation of such Sections may be authorized by the Executive Council upon the written petition of five or more Senior Members or Fellows. A Section shall be known as the........................Section of The Society of
(Name of place)
American Foresters.

SEC. 2. The officers of each Section shall consist of a chairman and a secretary and such others as may be found necessary.

SEC. 3. Any Section may, subject to the approval of the Executive Council, adopt for its own government such by-laws as it may find expedient, including the qualifications for associate members of the Section, provided that no part thereof shall conflict with the Constitution of the Society.

SEC. 4. No money from the general funds of the Society shall be appropriated or used for the expenses of a Section.

SEC. 5. Papers and discussions presented before any Section shall be the property of the Society, and the secretary of the Section shall forward a copy to the Editorial Board. The Editorial Board shall have full right to publish in the organ of the Society such papers as it may approve for publication. Papers and discussions not approved for publication by the Editorial Board shall be returned to the Section in which they originated.

SEC. 6. The Executive Council shall have the right at any time to rescind the authorization of any Section and to terminate its existence.

ARTICLE IX

PUBLICATION

SEC. 1. The Society shall publish such papers read before or contributed to it and in such form as the Editorial Board shall approve.

ARTICLE X

DUES

SEC. 1. The annual dues of Members shall be $4, and of Senior Members and Fellows $5. In each case $3 shall be in payment of subscription to the official publication of the Society. Dues shall be

payable in advance upon the first day of January, except that the dues of newly elected members for the year in which they are elected shall be payable from the date of their election.

SEC. 2. Associate and Honorary Members shall pay no dues.

SEC. 3. Any member whose dues are more than three (3) months in arrears shall be notified by the Treasurer. Should his dues not be paid when they become six (6) months in arrears, he shall lose the right to vote or to receive the publications of the Society until the obligation is discharged. Should his dues become nine (9) months in arrears, he shall again be notified by the Treasurer, and if such dues become one (1) year in arrears he shall forfeit his connection with the Society. The Executive Council, however, may, for cause deemed by it sufficient, extend the time for payment and for the application of these penalties.

ARTICLE XI

AMENDMENTS

This Constitution may be amended by letter-ballot by a three-fourths (¾) vote of the members voting, provided the proposed amendments have been submitted to all Senior Members and Fellows at least four (4) weeks in advance.

DECEMBER 1, 1917.

MEMBERS OF THE SOCIETY OF AMERICAN FORESTERS

Senior Members

	Date elected
Adams, Bristow, N. Y. State College of Agriculture, Ithaca, N. Y.	June 15, 1911
Adams, James Barry, 2438 Madison Ave., Ogden, Utah	Jan. 1, 1914
Ahern, George Patrick, 1431 Girard St. N. W., Washington, D. C.	Jan. 1, 1914
Akerman, Alfred, Greensboro, Ga	Apr. 2, 1903
Allen, Raymond Walter, Forest Service, Cody, Wyo	June 15, 1911
Allen, Shirley W., 144 Lascelles St., Syracuse, N. Y	Sept. 1, 1911
Allison, John Howard, University Farm, St. Paul, Minn	Feb. 18, 1909
Amadon, Clarence Henry, North Adams, Mass	May 15, 1915
Ames, Fred Elijah, Forest Service, Portland, Oregon	July 23, 1908
Andrews, Wm. T., Forest Service, Portland, Oregon	Nov. 17, 1916
Ashe, William Willard, Forest Service, Washington, D. C	Mar. 7, 1907
Ayres, Philip Wheelock, 4 Joy St., Boston, Mass	Mar. 7, 1907
Bailey, Irving Widmer, Bussey Bldg., Jamaica Plain, Mass	Apr. 1, 1914
Baker, F. S., Forest Service, Ephraim, Utah	Mar. 14, 1916

Date elected

Baker, Hugh Potter, N. Y. State Col. of Forestry, Syracuse, N. Y. . Mar. 7, 1907
Baker, James Frederick, N. Y. State Col. of Forestry, Syracuse, N. Y. . . . . Feb. 15, 1913
Bard, George Philip, 800 Penn St., Reading, Pa. . . . . June 15, 1911
Barrows, William Burnet, Forest Service, Washington, D. C. . . . . . . June 15, 1911
Bates, Carlos Glazier, Forest Service, Denver, Colo. . . . . Mar. 24, 1910
Benedict, Junius St. James, Forest Service, Asheville, N. C. . . . . Feb. 15, 1913
Bentley, John, Jr., Dept. of Forestry, N. Y. State College of Agriculture, Ithaca, N. Y. . . . . Nov. 17, 1916
Berry, Swift, Forest Service, San Francisco, Cal. . . . . Sept. 1, 1911
Besley, Fred Wilson, Johns Hopkins Univ., Baltimore, Md. . . . . July 23, 1908
Billard, Frederick Howell, c/o Lyon & Billard Co., Meriden, Conn. . Feb. 15, 1913
Birch, Dwight C., Forest Service, San Francisco, Cal. . . . . Nov. 18, 1915
Brewster, Donald Ross, Forest Service, Priest River, Idaho. . . . . . . July 1, 1914
Briscoe, John Manvers, University of Maine, Orono. Me. . . . . Apr. 1, 1914
Bristol, Harold Russell, c/o Delaware & Hudson Co., Plattsburg, N. Y. . . . . Feb. 15, 1913
Brooks, Philip P., 89 State St., Boston, Mass. . . . . Nov. 17, 1916
Brower, Asa L., Box 23, Ustick, Idaho. . . . . Nov. 17, 1916
Brown, Nelson C., N. Y. State College of Forestry, Syracuse, N. Y. Feb. 15, 1913
Bruce, Donald, Dept. of Forestry, Univ. of Cal., Berkeley, Cal. . . . . Feb. 15, 1913
Bruce, Eugene Sewell, 14 R. I. Ave. N. W., Washington, D. C. . . . . Jan. 1, 1914
Brundage, F. H., Forest Service, Portland, Oregon. . . . . Dec. 20, 1915
Bryant, Edward Sohier, Forest Service, Washington, D. C. . . . . Feb. 15, 1913
Bryant, Ralph Clement, Yale Forest School, New Haven, Conn. . . . Apr. 2, 1903
Burns, Findley, Forest Service, Washington, D. C. . . . . Feb. 18, 1909
Butler, Ovid McOuat, Forest Products Laboratory, Madison, Wis. . June 15, 1911

Calkins, Hugh Gilman, Forest Service, Albuquerque, N. Mex. . . . . . June 15, 1911
Campbell, R. H., Forestry Branch, Ottawa, Canada. . . . . May 4, 1916
Carter, Edward Edgecombe, Forest Service, Washington, D. C. . . . Mar. 7, 1907
Cary, Austin, Forest Service, Washington, D. C. . . . . Mar. 2, 1905
Cecil, George, Forest Service, Portland, Oregon. . . . . Nov. 17, 1917
Chaffee, Reginald Roscoe, Endeavor, Pa. . . . . Apr. 1, 1914
Chandler, Bernard Albert, Dept. of Forestry, State College of Agriculture, Ithaca, N. Y. . . . . May 15, 1915
Chapman, Herman Haupt, Forest Service, Albuquerque, N. Mex. . Mar. 7, 1905
Cheyney, Edward Gheen, University Farm, St. Paul, Minn. . . . . May 21, 1908
Chittenden, Alfred Knight, East Lansing, Mich. . . . . Apr. 2, 1903
Clapp, Earle Hart, Forest Service, Washington, D. C. . . . . Mar. 7, 1907
Clark, Ernest Dwight, Forest Service, Woodstock, Va. . . . . June 15, 1911
Clark, Elias Treat, Forest School, Univ. of Washington, Seattle, Wash. . . . . June 15, 1911
Clark, Fay G., Forest Service, Missoula, Mont. . . . . Nov. 17, 1916
Clark, Judson F., 520 Vancouver Block, Vancouver, B. C. . . . . July 23, 1908
Clark, William Darrow, Mass. Agr. College, Amherst, Mass. . . . . . . Feb. 15, 1913
Clement, George Edward, 75 Church St., Winchester, Mass. . . . . Apr. 2, 1903
Clifford, Edward C., R. F. D. No. 1, Woodfords, Me. . . . . Mar. 24, 1910
Coffman, John Daniel, Forest Service, Willows, Cal. . . . . Sept. 1, 1911

Date elected

Cohoon, Anson E., Forest Service, Medford, Oregon.............Apr. 28, 1909
Cook, Arthur Mayhew, Forest Service, Steamboat Springs, Colo...June 15, 1911
Cook, Harold O., State Forester's Office, Boston, Mass............Feb. 15, 1913
Coolidge, J. R., III, 89 State St., Boston, Mass....................Nov. 17, 1916
Coolidge, Philip Tripp, 31 Central St., Bangor, Me................June 15, 1911
Cox, William Thomas, State Forester, St. Paul, Minn.............Mar. 1, 1906
Cromie, George Alexander, 80 Water St., New Haven, Conn......May 15, 1915
Crowell, Lincoln, Sandwich, Mass.................................Apr. 1, 1914
Curran, Hugh McCollum, Box 114, Laurel, Md....................Mar. 7, 1905

Dana, Samuel Trask, Forest Service, Washington, D. C...........Apr. 28, 1909
Deering, R. L., Forest Service, Albuquerque, N. Mex..............Mar. 4, 1916
Detweiler, Samuel Bertolet, Office of Forest Pathology, U. S. Dept. of Agriculture, Washington, D. C.............................Mar. 7, 1907
Dieffenbach, Rudolph, Forest Service, Washington, D. C..........Jan. 1, 1916
Drake, Willard M., Univ. of Montana, Missoula, Mont.............June 15, 1911
Du Bois, Coert, Forest Service, San Francisco, Cal...............May 28, 1903
Dunlap, Frederick, Univ. of Missouri, Columbia, Mo...............June 6, 1907
Dunston, Clarence E., U. S. Indian Service, Washington, D. C....June 15, 1911
Dwight, Theodore Woolsey, Forestry Branch, Ottawa, Canada.....May 15, 1915

Eckbo, Nils B., Forest Service, Afton, Wyo.......................Nov. 17, 1916
Eldredge, Inman F., Forest Service, Pensacola, Fla................June 15, 1911
Erickson, Martin Lewis, Forest Service, Medford, Oregon.........June 23, 1908
Evans, Oscar Montgomery, 2125 Prince St., Berkeley, Cal.........May 17, 1915

Ferguson, John Arden, Pa. Dept. of Forestry, State College, Pa...June 15, 1911
Fernow, Bernhard Eduard, Univ. of Toronto, Toronto, Canada....Dec. 15, 1900
Fetherolf, James Milton, Forest Service, Ogden, Utah.............Mar. 1, 1906
Filley, Walter Owen, 144 Whalley Ave., New Haven, Conn........June 15, 1911
Fisher, Richard Thornton, Harvard Forest School, Jamaica Plain, Mass. ....Apr. 2, 1903
Foley, John, 413 Oak Lane, Wayne, Pa..........................Jan. 2, 1902
Foster, Harold Day, Forest Service, Medford, Oregon............June 15, 1911
Foster, John Harold, A. & M. College, College Station, Texas.....Mar. 24, 1910
Foxworthy, Fred William, Bureau of Forestry, Los Banos, Laguna, Luzon, P. I. ....June 15, 1911
French, H. Earl, Forest Service, Durango, Colo..................Mar. 14, 1916
Fromme, Rudo Lorenzo, Forest Service, Olympia, Wash..........Feb. 18, 1909
Frothingham, Earl Hazeltine, Forest Service, Washington, D. C...July 23, 1908

Gaskill, Alfred, State House, Trenton, N. J........................May 28, 1903
Gaylord, Frederick Alan, Nehasane Park, Nehasane, N. Y........June 15, 1911
Gibbons, W. H., Forest Service, Portland, Oregon................Dec. 20, 1915
Gifford, John Clayton, Cocoanut Grove, Dade County, Fla..........Apr. 3, 1902
Girard, James W., Forest Service, Missoula, Mont................Nov. 17, 1916
Goldsmith, Belknap Chittenden, Forest Service, Sisson, Cal........Sept. 1, 1911
Graff, Herbert, The Wisteria, 1315 Park Road, Washington, D. C...June 15, 1911

Date elected

Granger, Christopher Mabley, Forest Service, Denver, Colo.......Feb. 15, 1913
Graves, Henry Solon, Forest Service, Washington, D. C...........Dec. 13, 1900
Greeley, William Buckhout, Forest Service, Washington, D. C.....Feb. 3, 1906
Griffith, Edward Merriam, c/o Taggerts Paper Co., Watertown, N. Y. ....Dec. 15, 1900
Grondal, Bror L., University Station, Seattle, Wash...............Jan. 11, 1916
Gutches, G. A., District Inspector of Forest Reserves, Prince Albert, Sask., Canada ....Mar. 14, 1916
Guthrie, John Dennett, Forest Service, Flagstaff, Ariz.............Mar. 7, 1907

Hall, Rufus Clifford, Forest Service, Washington, D. C...........June 15, 1911
Hall, William Logan, Forest Service, Washington, D. C...........Dec. 13, 1900
Hammatt, Richard Fox, Forest Service, Sisson, Cal...............Sept. 1, 1911
Hanzlik, E. J., Forest Service, Olympia, Wash....................Nov. 17, 1916
Harris, Philip Talbot, Forest Service, Okanogan, Wash............Feb. 18, 1909
Hastings, A. B., State Forester's Office, Concord, N. H............Nov. 17, 1916
Hatton, John Henry, Forest Service, Denver, Colo................Mar. 2, 1905
Hawes, Austin Foster, Forest Service, Washington, D. C..........Mar. 2, 1905
Hawley, Ralph Chipman, Yale Forest School, New Haven, Conn..Feb. 3, 1906
Hazard, James Ovington, R. F. D., Tuckahoe, N. J................May 15, 1915
Headley, Roy, Forest Service, San Francisco, Cal.................Apr. 15, 1915
Heintzleman, B. Frank, Forest Service, Eugene, Oregon...........Dec. 20, 1915
Hill, Cary Leroy, 4416 Pleasant Valley Court, Oakland, Cal........June 6, 1907
Hirst, Edgar Clarkson, State Forester, Concord, N. H............June 15, 1911
Hodge, William Churchill, Jr., Fort Bragg, Cal...................Apr. 2, 1903
Hodgson, Allen H., Forest Service, Portland, Oregon.............Dec. 20, 1915
Hodson, Elmer Reed, Forest Service, Washington, D. C...........Mar. 7, 1907
Hoffman, A. F. C., Forest Service, Pagosa Springs, Colo..........Mar. 14, 1916
Hoffman, B. E., Forest Service, Medford, Oregon.................Dec. 20, 1915
Hofmann, J. V., Forest Service, Stabler, Wash....................Dec. 20, 1915
Holmes, John Simcox, Chapel Hill, N. C..........................June 6, 1907
Hopkins, Arthur Sherwood, c/o Conservation Com., Albany, N. Y..Apr. 1, 1914
Hopping, Ralph, Forest Service, San Francisco, Cal...............June 15, 1915
Hopson, W. A., R. F. D. No. 5, Gladwin, Mich....................Dec. 20, 1915
Hosmer, Ralph Sheldon, Cornell University, Ithaca, N. Y..........Dec. 13, 1900
Howard, William Gibbs, Conservation Com., Albany, N. Y........June 15, 1911
Howe, Clifton Durant, Univ. of Toronto, Toronto, Canada........May 15, 1915
Hutchinson, Wallace I., Forest Service, Denver, Colo.............Dec. 20, 1915

Illick, J. S., State Forest Academy, Mont Alto, Pa................Dec. 20, 1915
Imes, Richard Perry, Sidney, Mont..............................Mar. 7, 1907

Jack, John George, East Walpole, Mass.........................Jan. 1, 1914
Jackson, Alexander Grant, Forest Service, Portland, Oregon......Feb. 15, 1913
Jaenicke, A. J., Forest Service, Portland, Oregon.................Dec. 17, 1916
Jardine, James Tertius, Forest Service, Washington, D. C.........Jan. 1, 1914
Jeffers, D. S., Forest Service, Hot Sulphur Springs, Colo..........Mar. 14, 1916
Johnson, Fred R., Forest Service, Denver, Colo...................Dec. 20, 1915

Date elected

Johnson, Herman M., Forest Service, Eugene, Oregon............Dec. 20, 1915
Johnston, Don P., Forest Service, Albuquerque, N. Mex...........Mar. 14, 1916
Jones, Richard Chapin, Univ. of Virginia, Charlottesville, Va......July 1, 1914
Jotter, Ernst Victor, Forest Service, Weaverville, Cal.............May 15, 1915
Judd, Charles Sheldon, 2425 Manoa Ave., Honolulu, Hawaii.......Mar. 24, 1910

Keach, John Everett, Forest Service, Missoula, Mont.............June 6, 1907
Kelleter, Paul Delmar, Forest Service, Deadwood, S. Dak.........Feb. 18, 1909
Kellogg, Francis Bentley, Forest Service, Oakridge, Oregon.......Feb. 15, 1913
Kellogg, Royal Shaw, 925 Central Ave., Wilmette, Ill.............Mar. 7, 1905
Kempfer, William Herbert, Deer Park, Fla.......................Feb. 15, 1913
Kenety, William H., Cloquet Exp. Station, Cloquet, Minn.........Nov. 17, 1916
Kent, William H. B., Cazenovia, N. Y...........................Apr. 28, 1909
Kerr, A. F., 55 Twenty-seventh St., Corvallis, Oregon.............Dec. 20, 1915
Kiefer, Francis, 1731 Columbia Road, Washington, D. C..........June 15, 1911
King, A. H., c/o Conservation Commission, Albany, N. Y.........Mar. 24, 1916
Kinney, David Golden, 453 Holland Ave., Highland Park, Los Angeles, Cal. ....July 23, 1908
Kinney, Jay P., Indian Office, Washington, D. C..................Feb. 15, 1913
Kircher, Joseph Casimir, Santa Fe, N. Mex........................Apr. 1, 1915
Kirkland, Burt Persons, Dept. of Forestry, Univ. of Washington, Seattle, Wash. ....Feb. 18, 1909
Kneipp, Leon Frederick, Forest Service, Ogden, Utah.............Jan. 1, 1914
Koch, Elers, Forest Service, Missoula, Mont......................Mar. 7, 1905
Korstian, C. F., Forest Service, Ogden, Utah.....................Mar. 14, 1916
Krauch, Hermann, Porvenir, San Miguel County, N. Mex.........May 15, 1915
Kummel, Julius F., Forest Service, Portland, Oregon.............Mar. 24, 1910
Kupfer, Carl Albert, Forest Service, San Francisco, Cal...........June 15, 1911

Lafon, John, Jr., c/o Minister of Lands, Victoria, B. C...........Feb. 15, 1913
Lamb, Geo. N., Forest Service, Washington, D. C................Nov. 17, 1916
Larsen, Louis T., Forest Service, Nevada City, Cal................May 18, 1915
Leavitt, Clyde, c/o Conservation Com., Ottawa, Canada...........July 23, 1908
Leopold, Aldo, Forest Service, Albuquerque, N. Mex..............Feb. 15, 1913
Lovejoy, Parish Storrs, 1137 Fair Oaks, Ann Arbor, Mich.........June 15, 1911

MacDaniels, E. H., Forest Service, Chelan, Wash.................Nov. 17, 1916
Macdonald, Gilmore B., Iowa Exp. Station, Ames, Iowa...........June 15, 1911
Macduff, Nelson Ferris, Forest Service, Grants Pass, Oregon.....June 15, 1911
MacKaye, Benton, Forest Service, Washington, D. C..............June 15, 1911
MacMillan, H. R., Victoria Lbr. & Mfg. Co., Ltd., Chemainus, B. C., Canada ....Dec. 20, 1915
Maddox, Rufus Sherrell, c/o State Geological Survey, Nashville, Tenn. ....Sept. 1, 1911
Malven, S. St. J., Forest Service, Kalispell, Mont.................Nov. 17, 1916
Marsh, R. E., Forest Service, Taos, N. Mex......................Mar. 14, 1916
Marston, Roy Leon, Skowhegan, Me..............................May 28, 1903
Martin, Clyde Sayers, c/o Cherry Valley Timber Co., Stillwater, Wash. ....Apr. 1, 1914

Date elected

Mason, David Townsend, Univ. of California, Berkeley, Cal.......Mar. 24, 1910
Mast, William Herbert, Davenport, Iowa.........................July 23, 1908
Mathews, Donald M., Chief Forester, Sandacan, British North Borneo ....Feb. 15, 1913
Mattoon, W. R., Forest Service, Washington, D. C................Mar. 1, 1906
Maule, William M., Forest Service, Gardnerville, Nev.............Feb. 18, 1909
McCain, A. C., Forest Service, Ogden, Utah......................Mar. 14, 1916
McCarthy, E. F., State Ranger School, Wanakena, N. Y..........Mar. 14, 1916
McLean, Forman Taylor, College of Agriculture, Univ. of the Philippines, Los Banos, P. I.....................................June 15, 1911
Meinecke, Emile P., Forest Service, San Francisco, Cal...........Jan. 1, 1914
Merritt, Melvin L., Forest Service, Portland, Oregon.............Feb. 15, 1913
Metcalf, Woodbridge, Agr. Exp. Sta., Univ. of Calif., Berkeley, Cal. Dec. 20, 1915
Millar, Willis Norman, Faculty of Forestry, 11 Queens Park, Toronto, Canada ....Sept. 1, 1911
Miller, Francis Garner, Univ. of Idaho, Moscow, Idaho...........Mar. 5, 1904
Miller, R. B., Univ. of New Brunswick, Fredericton, N. B., Canada. Dec. 20, 1915
Mitchell, John Alfred, Forest Service, Washington, D. C..........Sept. 1, 1911
Moody, Frank Benjamin, State Forester, Madison, Wis...........Feb. 18, 1909
Moon, Frederick Franklin, N. Y. State College of Forestry, Syracuse, N. Y. ....June 15, 1911
Moore, Barrington, 925 Park Ave., New York City...............June 15, 1911
Moore, Sydney Luard, 4 East Bay St., Jacksonville, Fla............May 21, 1908
Moore, Walter Morrison, Forest Service, Washington, D. C.......June 15, 1911
Morbeck, George Chester, State College, Ames, Iowa.............Apr. 1, 1914
Morrell, Fred W., Forest Service, Denver, Colo...................July 23, 1908
Mulford, Walter, Univ. of California, Berkeley, Cal..............Mar. 5, 1904
Munger, Thornton Taft, Forest Service, Portland, Oregon........Mar. 24, 1910
Murphy, Louis Sutliffe, Forest Service, Washington, D. C........Mar. 24, 1910

Neel, Harry Camble, Dravosburg, Pa.............................July 23, 1908
Nellis, J. C., Forest Service, Washington, D. C..................Mar. 14, 1916
Nelson, John Marburg, P. & R. C. & I. Co., Pottsville, Pa.........June 6, 1907
Newins, Harold Stephenson, Oreg. Agric. Col., Corvallis, Oregon.. May 15, 1915
Notestein, Frank Browning, 500 Delaware St. S. E., Minneapolis, Minn. ....July 1, 1914

Oakleaf, Howard B., Forest Service, Portland, Oregon............Dec. 20, 1915
Olmsted, Frederick Erskine, Stanford University, California.......Dec. 15, 1900
Oman, Andrew Edward, Forest Service, Ogden, Utah.............May 21, 1908
Osborne, Wm. B., Jr., Forest Service, Portland, Oregon...........Dec. 20, 1915

Parker, Rutledge, Forest Service, Missoula, Mont.................July 1, 1914
Parkinson, Dana, 2015 Resseguie St., Boise, Idaho................Mar. 14, 1916
Paxton, Percy J., Forest Service, Denver, Colo....................Mar. 14, 1916
Pearson, Gustav Adolph, Forest Service, Flagstaff, Ariz...........Mar. 24, 1910
Peavy, George Wilcox, Oregon Agric. Col., Corvallis, Oregon......Mar. 1, 1906
Peck, Allen Steele, Forest Service, Washington, D. C.............June 6, 1907

	Date elected
Peters, James Girvin, Forest Service, Washington, D. C.	Mar. 7, 1905
Pettis, Clifford Robert, Conservation Com., Albany, N. Y.	July 23, 1908
Philips, Ress, Room 463, New Federal Bldg., Denver, Colo.	Dec. 20, 1915
Piché, G. C., 64 St. Cyrille Street, Quebec, Canada	Dec. 14, 1915
Pinchot, Gifford, 1617 Rhode Island Ave., Washington, D. C.	Dec. 13, 1900
Piper, William Bridge, East Tawas, Michigan	June 15, 1911
Potter, Albert Franklin, Forest Service, Washington, D. C.	June 15, 1911
Pratt, Merritt Berry, Division of Forestry, Univ. of Cal., Berkeley, Cal.	July 23, 1908
Preston, John F., Forest Service, Missoula, Mont.	June 15, 1911
Ramskill, Jerome Hinds, c/o Burma Mine, Ltd., Nam Tu, Upper Shann States, Burma, India	June 15, 1911
Randles, Quincy, Forest Service, Albuquerque, N. Mex.	Nov. 27, 1916
Recknagel, Arthur Bernard, College of Agriculture, Cornell University, Ithaca, N. Y.	May 21, 1908
Redington, Paul Goodwin, Forest Service, Albuquerque, N. Mex.	Feb. 3, 1906
Reed, Franklin Weld, Forest Service, Washington, D. C.	Mar. 5, 1904
Reynolds, Robt. Van Rensselaer, Forest Service, Washington, D. C.	June 15, 1911
Rhoades, Verne, Box 77, Asheville, N. C.	Dec. 20, 1915
Riley, Smith, Forest Service, Denver, Colo.	Mar. 2, 1905
Ringland, Arthur Cuming, Forest Service, Washington, D. C.	July 23, 1908
Rockwell, Frank I., Forest Service, Cœur d'Alene, Idaho	Sept. 1, 1911
Rogers, David Nathan, Forest Service, Quincy, Cal.	Sept. 1, 1911
Rogers, J. S., Centre Sandwich, N. H.	Nov. 17, 1916
Roth, Filibert, University of Michigan, Ann Arbor, Mich.	Dec. 15, 1900
Rothery, Julian Eastman, 527 Fifth Ave., New York, N. Y.	June 15, 1911
Rothkugel, Max, Florida 524, Officina de Bosques, Buenos Aires, Argentina	July 23, 1908
Sanford, F. H., Box 520, East Lansing, Mich.	Dec. 20, 1915
Saxton, Jas. B., Arlee, Mont.	Mar. 14, 1916
Schwarz, George Frederick, 1470 Beacon St., Brookline, Mass.	Feb. 2, 1902
Scott, Charles Anderson, Agricultural College, Manhattan, Kans.	Mar. 1, 1906
Sewall, James Wingate, Oldtown, Me.	May 15, 1915
Shattuck, C. H., 928 Fresno Ave., Berkeley, Cal.	Dec. 20, 1915
Shepard, E. C., Forest Service, Logan Utah	Mar. 14, 1916
Shepard, William Chambers, R. F. D. 59, Berlin, Conn.	June 15, 1911
Sherfesee, William Forsythe, Peking, China	Mar. 7, 1907
Sherman, E. A., Forest Service, Washington, D. C.	Dec. 20, 1915
Sherrard, Thomas Herrick, Forest Service, Portland, Oregon	Dec. 13, 1900
Shinn, Charles Howard, Forest Service, Northfork, Cal.	Mar. 7, 1907
Siecke, Eric Otto, Salem, Oregon	July 23, 1908
Silcox, Ferdinand Augustus, Forest Service, Missoula, Mont.	June 6, 1907
Simpson, Alva A., Forest Service, Saguache, Colo.	Dec. 20, 1915
Skeels, Dorr, Forest School, Univ. of Mont., Missoula, Mont.	Sept. 1, 1911
Smith, Clinton Gold, Forest Service, Washington, D. C.	Feb. 18, 1909
Smith, Charles Stowell, Cal. White and Sugar Pine Ass'n, San Francisco, Cal.	Mar. 24, 1910

Date elected

Smith, Percy T., Forest Service, Gunnison, Colo..................May 15, 1915
Smith, Stanton Gould, 806 Securities Bldg., Seattle, Wash.........Feb. 18, 1909
Somers, John B., Forest Service, Dillon, Mont....................Nov. 27, 1916
Sparhawk, W. N., Forest Service, Washington, D. C..............Mar. 14, 1916
Spaulding, Thomas Claude, Forest School, Univ. of Montana, Missoula, Mont..July 1, 1914
Sponsler, Octavius Lee, 1332 Forest Court, Ann Arbor, Mich......June 15, 1911
Spring, Samuel Newton, Col. of Agr., Cornell Univ., Ithaca, N. Y..Mar. 5, 1904
Stabler, Herbert Osburn, Forest Service, Washington, D. C.......July 23, 1908
Stahl, C. J., Forest Service, Denver, Colo.........................Mar. 14, 1916
Stephen, John Wallace, 1031 Euclid Ave., Syracuse, N. Y.........June 15, 1911
Sterling, Ernest Albert, National Lbr. Mfrs. Ass'n. 11 South La Salle St., Chicago, Ill..Apr. 2, 1903
Sterrett, William Dent, Forest Service, Washington, D. C.........Feb. 3, 1906
Stevens, Carl M., Forest Service, Thompson Falls, Mont..........Nov. 17, 1916
Stokes, J. Warrington, Forest Service, Burley, Idaho..............Nov. 17, 1916
Stuart, Robert Young, Forest Service, Washington, D. C..........June 15, 1911
Sudworth, George Bishop, Forest Service, Washington, D. C.......Dec. 15, 1900
Swann, Orrington Thomas, Oshkosh, Wis..........................Sept. 1, 1911
Sweeney, Michael J., Forest Service, Lander, Wyo................Jan. 3, 1916
Sylvester, A. H., Forest Service, Leavenworth, Wash.............Mar. 14, 1916

Terry, Elwood Idell, Bussey Institution, Jamaica Plain, Mass......Sept. 1, 1911
Thompson, M. W., Forest Service, Denver, Colo.................Jan. 3, 1916
Tiemann, Harry Donald, Forest Service, Madison, Wis............Mar. 2, 1905
Tierney, Dillon Parnell, 301 State Capitol, St. Paul, Minn..........June 15, 1911
Tillotson, Claude Raymond, Forest Service, Washington, D. C....June 15, 1911
Tompkins, Harry James, Room 207, Federal Bldg., Pasadena, Cal...Jan. 2, 1902
Toumey, James William, Yale Forest School, New Haven, Conn...Dec. 15, 1900
Truax, T. R., Iowa State College, Ames, Iowa....................Mar. 21, 1916

Upson, Arthur T., Forest Service, Aspen, Colo...................Apr. 1, 1914

Viles, Blaine Spooner, Augusta Trust Bldg., Augusta, Me..........July 23, 1908
Von Bayer, William Hector, Indian Office, Washington, D. C......May 21, 1908

Waha, Alpheus Oliver, Forest Service, Washington, D. C.........May 21, 1908
Warner, Joseph De Witt, Forest Service, Kalispell, Mont..........July 23, 1908
Weber, William Hoyt, 151 Courtland Ave., Stamford, Conn........June 15, 1911
Weigle, William Grant, Forest Service, Ketchikan, Alaska.........Feb. 3, 1906
Weiss, Howard Frederick, C. F. Burgess Laboratories, Madison, Wis. ....June 6, 1907
Wentling, John Philip, Univ. of Minnesota, St. Paul, Minn........July 23, 1908
White, Edgar Fowler, Forest Service, Missoula, Mont............July 1, 1914
White, J. H., University of Toronto, Toronto, Canada............May 15, 1915
Whitford, Harry Nichols, Yale Forest School, New Haven, Conn..Sept. 1, 1911
Wilber, Charles Parker, State House, Trenton, N. J...............June 15, 1911
Williams, Asa Starkweather, 503 Winch Bldg., Vancouver, B. C...Apr. 28, 1909

Date elected

Williams, H. C., Forest Service, McCall, Idaho..................Apr. 26, 1916
Willis, Clarence B., Naturita, Colo..............................Feb. 15, 1913
Wilson, Elwood, c/o Laurentide Paper Co., Grand Mere, P. Q., Canada ....May 15, 1915
Winkenwerder, Hugo, University of Washington, Seattle, Wash...Sept. 1, 1911
Wirt, George H., Department of Forestry, Harrisburg, Pa........Mar. 24, 1910
Wolff, Meyer H., Forest Service, Cœur d'Alene, Idaho............Dec. 20, 1915
Woodbury, Truman Doane, Forest Service, San Francisco, Cal....July 23, 1908
Woodward, Karl Wilson, New Hampshire College, Durham, N. H. Feb. 3, 1906
Woolsey, Theodore Salisbury, Jr., 250 Church St., New Haven, Conn. ....Mar. 7, 1905
Work, Herman, Forest Service, Montpelier, Idaho................Mar. 14, 1916
Worthley, Irving Tupper, Broad Street Station, Philadelphia, Pa...June 15, 1911

Yarnell, Ira T., Forest Service, Flagstaff, Ariz...................Mar. 14, 1916
Young, Leigh H., University of Michigan, Ann Arbor, Mich......Mar. 14, 1916

Zavitz, E. J., Dept. of Lands, Forests and Mines, Toronto, Canada..Dec. 20, 1915
Ziegler, E. A., Mont Alto, Pa......................................June 6, 1907
Zon, Raphael, Forest Service, Washington, D. C.................Mar. 5, 1904

Associate Members

Adams, Dr. Charles C., New York State College of Forestry, Syracuse, N. Y. ....Nov. 17, 1916
Allen, G. F., Forest Service, Tacoma, Wash......................Mar. 14, 1916
Barber, Jno. R., 502 West Roosevelt St., Phœnix, Ariz............July 1, 1914
Betts, H. S., Forest Service, Washington, D. C...................July 23, 1908
Bonner, Frank E., Forest Service, Washington, D. C...............July 1, 1914
Britton, Dr. N. L., New York Botanical Garden, Bronx Park, New York City ....Dec. 20, 1915
Burgess, A. F., 43 Tremont St., Boston, Mass.....................Dec. 20, 1915
Burns, Prof. Geo. P., University of Vermont, Burlington, Vt......July 1, 1914
Clements, Prof. F. E., Univ. of Minn., Minneapolis, Minn.........Feb. 15, 1913
Cooper, Lee E., Forest Service, Pinedale, Wyo....................Mar. 14, 1916
Coville, Bureau of Plant Industry, Washington, D. C..............Dec. 13, 1900
Cowles, Henry C., University of Cheiago, Chicago, Ill............Dec. 20, 1915
Douglas, L. H., Forest Service, Denver, Colo.....................Dec. 20, 1915
Fenn, F. A., 419 Eddy Ave., Missoula, Mont.......................July 23, 1908
French, H. H., Forest Service, Glenwood Springs, Colo...........Mar. 14, 1916
Harper, Roland M., 555 First Ave., College Point, New York......Dec. 20, 1915
Herty, Dr. C. H., Univ. of North Carolina, Chapel Hill, N. C.......Apr. 26, 1905
House, Dr. H. P., State Botanist, Education Bldg., Albany, N. Y...Nov. 17, 1916
Humphrey, C. J., Forest Products Laboratory, Madison, Wis......Feb. 15, 1913
Kreutzer, W. R., Forest Service, Gunnison, Colo..................Apr. 26, 1916
Lukens, T. P., 343 Waverly Drive, Pasadena, Cal..................Apr. 26, 1905
Marshall, G. E., Forest Service, Cass Lake, Minn.................Apr. 26, 1916
McLaren, John, 2842 Raleigh St., Denver, Colo....................Mar. 14, 1916

	Date elected
Merriam, Dr. C. Hart, 1919 16th St., Washington, D. C.	Jan. 2, 1902
Merrill, O. C., Forest Service, Washington, D. C.	Nov. 17, 1916
Metcalf, Dr. Haven, Bureau of Plant Industry, Washington, D. C.	June 15, 1911
Miller, John M., Bureau of Entomology, Ashland, Oregon	Sept. 1, 1911
Myers, George Hewitt, 2310 S St., Washington, D. C.	Apr. 1, 1914
Nelson, E. W., Biological Survey, Washington, D. C.	Dec. 20, 1915
Nelson, J. W., Forest Service, Washington, D. C.	Feb. 23, 1916
Norcross, T. W., Forest Service, Washington, D. C.	Nov. 17, 1916
Palmer, T. S., 1939 Biltmore St. N. W., Washington, D. C.	Dec. 20, 1915
Pammel, L. H., Iowa State College, Ames, Iowa	Dec. 20, 1915
Pitchlynn, Paul P., c/o Forest Service, Snowflake, Ariz.	May 15, 1915
Pool, R. J., Univ. of Nebraska, Lincoln, Nebr.	Mar. 14, 1916
Pratt, George D., Conservation Commission, Albany, N. Y.	Nov. 17, 1916
Reynolds, H. A., c/o Mass. Forestry Ass'n, 4 Joy St., Boston, Mass.	Dec. —, 1915
Rhodes, J. E., Interstate Bank Bldg., New Orleans, La.	Feb. 15, 1913
Ridsdale, P. S., Sec'y American Forestry Ass'n, 1410 H St. N. W., Washington, D. C.	Dec. 20, 1915
Sampson, Arthur W., Forest Service, Ephraim, Utah	Apr. 1, 1914
Shaw, E. W., Forest Service, Livingston, Mont.	Mar. 22, 1916
Shreve, Forrest, Desert Laboratory, Tucson, Ariz.	Dec. 20, 1915
Smith, H. A., Forest Service, Washington, D. C.	Jan. 1, 1914
Webb, Dr. W. S., Shelburne, Vt.	Jan. 3, 1901
Weir, Dr. James R., First National Bank Bldg., Missoula, Mont.	July 1, 1914
Wells, Philip P., Metropolitan Bank Bldg., Washington, D. C.	July 23, 1908
Whipple, J. S., Dept. of Excise, Albany, N. Y.	Dec. 20, 1915
Winn, Frederick, Forest Service, Springerville, Ariz.	Apr. 1, 1914
Woodruff, G. W., Pocahontas Coal Co., 1 Broadway, New York	Mar. 14, 1905

Honorary Members

Andrews, Gen. C. C., State Fire Warden, St. Paul, Minn.	Jan. 1, 1914
Bowers, Prof. E. A., 258 St. Ronan St., New Haven, Conn.	Jan. 1, 1914
Clutterbuck, P. H., Deputy Conservator of Forests, Naini Tal, India	Mar. 24, 1910
Elliott, S. B., Reynoldsville, Pa.	Jan. 1, 1914
Francis, Hon. D. R., St. Louis, Mo.	Jan. 1, 1914
Hague, Dr. Arnold, Geological Survey, Washington, D. C.	Jan. 1, 1914
Newell, Prof. F. H., 1109 California St., Urbana, Ill.	Jan. 1, 1914
Roosevelt, Hon. Theodore, Oyster Bay, N. Y.	Jan. 1, 1914
Rothrock, J. T., 428 North Church St., West Chester, Pa.	Nov. 27, 1916
Sargent, Prof. C. S., Jamaica Plain, Mass.	Jan. 1, 1914
Spalding, Dr. Volney M., Loma Linda, Cal.	Jan. 1, 1914
Walcott, Hon. C. D., Smithsonian Institute, Washington, D. C.	Jan. 1, 1914
Waldo, Hon. J. B., Macleay, Oregon	Jan. 1, 1914
Wilson, Hon. James, Traer, Iowa	Jan. 1, 1914

Deceased Members

Name	Membership	Date of election	Date of death
Bessey, Charles Edwin	Honorary	Jan. 2, 1902	Feb. 27, 1915
Black, Frank Swett	Associate	Jan. 3, 1901	Mar. 16, 1913
Brandis, Sir Dietrich	Honorary	May 28, 1903	May 28, 1907
Brewer, William Henry	Associate	Feb. 7, 1901	Nov. 2, 1910
Clark, Willard Weld	Active	Apr. 2, 1903	July 30, 1909
Cleveland, Grover	Associate	Jan. 3, 1901	June 24, 1908
Dudley, William Russell	Associate	Feb. 7, 1901	June 4, 1911
Egleston, Nathaniel Hillyer	Associate	Feb. 7, 1901	Aug. 24, 1912
Fox, William Freeman	Associate	Dec. 13, 1900	June 16, 1909
Furnas, Robert Wilkinson	Associate	Jan. 2, 1902	—— —, 1905
Gannett, Henry	Associate	Dec. 13, 1900	Nov. 5, 1914
Gardner, Wesley Johnson	Active	Mar. 5, 1904	June 14, 1906
Gibbs, Wolcott	Associate	Apr. 3, 1902	Dec. 9, 1908
Harrison, Benjamin	Associate	Jan. 3, 1901	Mar. 14, 1901
Hitchcock, Ethan Allen	Associate	Apr. 3, 1902	Apr. 9, 1909
Holmes, Joseph Austin	Honorary	Jan. 1, 1914	July 13, 1915
Hubbard, William Fairchild	Active	May 28, 1903	July 17, 1905
Jesup, Morris Ketchum	Associate	Apr. 3, 1902	Jan. 22, 1908
Knechtel, Abraham	Active	Mar. 1, 1906	Dec. 10, 1915
Margolin, Louis	Active	Feb. 3, 1906	June 20, 1914
Miller, Louis Christian	Active	Mar. 7, 1905	July 16, 1910
Mohr, Charles	Associate	Feb. 7, 1901	Apr. 27, 1902
Morton, Julius Sterling	Associate	Jan. 2, 1902	Apr. 27, 1902
Murdock, John, Jr.	Active	June 15, 1911	Jan. 29, 1915
Noble, J. W.	Honorary	Jan. 1, 1914	May 25, 1915
Phillips, Frank Jay	Active	July 23, 1908	Feb. 13, 1911
Pinchot, James Warren	Associate	Jan. 3, 1901	Feb. 7, 1908
Plummer, Fred Gordon	Active	July 23, 1908	Aug. 15, 1913
Price, Overton Westfeldt	Active	Dec. 13, 1900	June 11, 1914
Rogers, Robert Lansing	Active	June 15, 1911	May 25, 1915
Vanderbilt, George Washington	Associate	Feb. 7, 1901	Mar. —, 1914
Whitney, William Collins	Associate	Jan. 3, 1901	Feb. 2, 1904
Wiggins, Benjamin Lawton	Associate	Jan. 3, 1901	June 14, 1909

CONTENTS